Joint Industry Project Study Plan for Treatment, Completion, and Workover Discharges

USEPA Region 4 NPDES General Permit No. GEG460000
USEPA Region 6 NPDES General Permit No. GMG290000

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Acronym List

Acronym	Explanation
°F	Degrees Fahrenheit
%	Percent
‰	Parts per Thousand
µg/L	Microgram per Liter
µm	Micrometer
amu	Atomic Mass Unit
API	American Petroleum Institute
bbl	Barrel
BCF	Bioconcentration Factor
BOD	Biochemical Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
$C_{crit.dil.}$	Concentration at the Critical Dilution
CCST	California Council on Science and Technology
CMC	Criterion Maximum Concentration
CORMIX	Cornell Expert Mixing Model
CV	Coefficient of Variation
CWA	Clean Water Act
DOC	Dissolved Organic Carbon
DQO	Data Quality Objective
ECHA	European Chemicals Agency
ECOTOX	ECOTOXicology Database
EEUSA	Environmental Enterprises USA, Inc.
EMTL	Element Materials Technology Lafayette
EPISuite	Estimation Programs Interface Suite
ft.	Feet
g/mL	Grams per Milliliter
GMAV	Genus Mean Acute Value
GOM	Gulf of Mexico
GP	General Permit
HDPE	High Density Polyethylene
HMW	High Molecular Weight
HQ	Hazard Quotient
IC25	25% Inhibition Concentration
in.	Inch
JIP	Joint Industry Project
Kow	*n*-octanol/Water Partition Coefficient
L	Liter
LC50	50 Percent Median Lethal Concentration
LCS	Laboratory Control Sample
LOEC	Lowest Observed Effect Concentration
log	Base 10 logarithm
LMW	Low Molecular Weight
m	Meter
$mi.^2$	Square Miles
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MVI	Marine Ventures International
MW	Molecular Weight
NOEC	No Observed Effect Concentration
NPDES	National Pollutant Discharge Elimination System
O&G	Oil and Gas

Acronym	Explanation
OC	Organic Carbon
OCS	Outer Continental Shelf
OECD	Organization for Economic Co-operation and Development (OECD)
OOC	Offshore Operators Committee
OWS	Oil Water Separator
p	Probability
PAH	Polycyclic Aromatic Hydrocarbon
PAM	Polyacrylamide
PP	Priority Pollutant
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
SAP	Sampling and Analysis Plan
SDS	Safety Data Sheet
SMAV	Species Mean Acute Value
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
TAC	Test Acceptability Criteria
TAT	Turnaround Time
TCW	Treatment, Completion, and Workover
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound
WET	Whole Effluent Toxicity

1.0 Introduction

AECOM and Marine Ventures International (MVI) prepared this draft treatment, completion, and workover (TCW) fluid and TCW discharge characterization study plan (the "study plan") in cooperation with the Offshore Operators Committee (OOC).[1] The study plan was prepared in support of a joint industry project (JIP) study to characterize TCW fluids and TCW discharges from offshore oil and gas (O&G) discharge locations to Gulf of Mexico (GOM) surface waters.[2,3]

The study plan was prepared in accordance with U.S. Environmental Protection Agency (USEPA) requirements for the "Industry-Wide Study Alternative" and addresses verbal comments on a conceptual study approach received from USEPA Regions 4 and 6 on September 5, 2018. Industry-Wide Study requirements are specified in the GOM National Pollutant Discharge Elimination System (NPDES) General Permits (GPs) for USEPA Regions 4 and 6.[4] Study requirements include evaluating TCW fluid and TCW discharge chemical composition and the potential for aquatic toxicity.

1.1 Purpose and Objectives

The purpose of the study plan is to present an approach to data collection and analysis that complies with GP requirements for the Industry-Wide Study Alternative. The objectives of the JIP study are to characterize: (1) the chemical composition of TCW fluids and TCW discharges, and (2) their potential to cause aquatic toxicity to GOM aquatic receptors. To achieve these objectives, this study plan addresses the following study questions:

- What constituents are currently used in TCW fluids? What are their general aquatic hazard characteristics?
- How are TCW discharges typically handled and their discharge to GOM surface waters managed?
- What is the typical chemical composition of TCW discharges?
- What are the estimated concentrations of constituents in GOM surface waters at the critical effluent dilution, i.e., the concentration predicted to exist in the discharge plume at the edge of the 100 meter (m) mixing zone?
- What is the potential for the constituents in TCW discharges to cause acute aquatic toxicity at the critical effluent dilution?
- Which constituents in TCW discharges are likely to be associated with acute aquatic toxicity, if effects are observed?

1.2 Document Organization

The study plan consists of the following sections:

- Section 2.0 provides the regulatory context for the JIP study;

[1] The OOC is the O&G industry's principal representative for the regulation of offshore exploration, development, and producing operations in the GOM.
[2] Once approved by USEPA, the plan will become an enforceable part of the GOM NPDES permit. The study can be conducted as an alternative to conducting discharge monitoring and reporting. If the Region does not approve the plan or if a permittee does not participate in the industry-wide study, JIP study participants are required to submit discharge assessment results on March 30, 2019; March 30, 2020; March 30, 2021; and October 1, 2021.
[3] The western and central planning regions.
[4] In accordance with GOM NPDES Permit No. GMG290000 (USEPA Region 6; effective date October 1, 2017) and GOM NPDES Permit No. GEG460000 (USEPA Region 4; effective date January 20, 2018).

- Section 3.0 presents an overview of TCW discharge characteristics;
- Section 4.0 presents the sampling and analysis plan (SAP);
- Section 5.0 discusses reporting;
- Section 6.0 identifies the schedule;
- Section 7.0 presents the study team organization; and
- Section 8.0 lists the references cited in this plan.

2.0 Regulatory Context

This section presents the regulatory context of the study, including an overview of the NPDES GPs and a discussion of the Industry-Wide Study Alternative.

2.1 Overview of the NPDES GPs

Water resources in the U.S. are protected under the Clean Water Act (CWA). In accordance with Section 402 of the CWA, the USEPA is authorized to issue NPDES GPs to regulate the discharges of pollutants to waters of the U.S., the territorial sea, contiguous zone, and the ocean. TCW discharges to GOM federal waters are regulated under the following NPDES GPs:

- No. GEG460000 (USEPA Region 4; effective date January 20, 2018); and
- No. GMG290000 (USEPA Region 6; effective date October 1, 2017).

2.2 Industry-Wide Study Alternative

As discussed in the GPs, Permittees that discharge to GOM surface waters have the option of conducting a study under the USEPA's Industry-Wide Study Alternative. The study is an alternative to (1) monitoring TCW fluid characteristics, and (2) reporting information on associated operations. The information collected under the proposed study will constitute compliance with GP monitoring requirements for JIP study participants. The following sub-sections summarize Industry-Wide Study requirements; identify JIP study participants; and document the outcome of a September 5, 2018 meeting with the USEPA.

2.2.1 Study Requirements

GP data requirements for TCW discharge evaluations are presented by USEPA Region in **Table 2-1**; the requirements for the Industry-Wide Study stated in the USEPA Region 6 GP are provided below:[5]

> *"Industry-Wide Study Alternative: Alternatively, operators who discharge well treatment completion and/or workover fluids may participate in an EPA-approved industry-wide study as an alternative to conducting monitoring of the fluids characteristic and reporting information on the associated operations. That study would, at a minimum, provide a characterization of well treatment, completion, and workover fluids used in a representative number of wells discharging well treatment, completion, and/or workover fluids. In addition, an approved industry-wide study would be expected to provide greater detail on the characteristics of the resulting discharges, including their chemical composition and the variability of the chemical composition and toxicity. The study area should include a statistical[ly] valid number of samples of wells located in the Western and Central Areas of the GOM and may include the Eastern Gulf of Mexico (GOM) under the permitting jurisdiction of EPA Region 4, and operators may join the study after the start date. The study plan should also include interim dates/milestones.*

[5] Study requirements for USEPA Region 4 are similar, with the following exceptions: (1) discharge samples should be collected from "various well depths (shallow, medium, and deep)"; (2) the study plan would need to be submitted within 6-18 months of the GP effective date; and (3) the final study report should be submitted no later than 4 years from the GP effective date.

A plan for an industry–wide study would be required to be submitted to EPA for approval within eighteen (18) months after the effective date of this permit. If the Region approves an equivalent industry-wide well treatment fluids discharge monitoring study, the monitoring conducted under that study shall constitute compliance with these monitoring requirements for permittees who participate in the industry-wide study.

Once approved, the study plan will become an enforceable part of this permit. The study must commence within six months of EPA's approval. The final study report must be submitted no later than October 1, 2021."

2.2.2 JIP Study Participants

The Industry-Wide Study Alternative was selected by 28 operators and service providers, i.e., JIP study participants, under the auspices of the OOC:

Anadarko	Hess
Ankor Energy	LLOG
Arena Offshore	Marubeni
BP	Medco Energi
Byron Energy	Murphy E&P
Chevron	Newpark
Contango	Northstar
ENI US Operating	Petrobras America
EnVen	Shell
Equinor	Talos Energy Inc.
ExxonMobil	TETRA
Fieldwood	Total
Halliburton	W&T Offshore
Helis	Walter Oil & Gas

2.2.3 Meeting with USEPA Regions 4 and 6

On September 5, 2018, a meeting was held with USEPA Regions 4 and 6; representatives from the OOC; JIP study participants; and AECOM/MVI.[6] The purpose of the meeting was to seek USEPA concurrence on a conceptual study plan approach to the Industry-Wide Study Alternative and identify a path forward. The conceptual approach consists of three steps as described in **Section 4.0**: (1) preliminary characterization; (2) sample collection and analysis; and (3) data evaluation. USEPA agreed (verbally) with the conceptual approach and indicated that more detailed comments would be provided following review of a draft study plan.[7] The following are a summary of topics discussed during the September 5, 2018 meeting:

- **Study plan submittal schedule**: USEPA requested that a draft of the proposed study plan be provided for review in early November, followed by a conference call to discuss. This schedule was updated (see **Section 6 Study Schedule**). USEPA also stated that the OOC could commence TCW sampling activities before receiving formal USEPA approval of the study plan.

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[6] Meeting Attendees: **In person**: Greg Southworth (OOC); Jim Floyd (Chevron); Joe Smith (MVI); Ray Arnold (Chevron); Dani Belhateche (AECOM); Sofia Lamon (Anadarko); Isaac Chen (USEPA Region 6); Mitty Mohon (USEPA Region 6). **By phone**: Jeffrey Park (AECOM); Ashley Haynes (Fieldwood); Sara Hughes (Shell); Karrie Jo Shell (USEPA Region 4); Bridget Staples (USEPA Region 4); and Scott Wilson (USEPA Region 4 Headquarters).

[7] A follow-up meeting to discuss the draft plan was originally scheduled for December 2018.

- **Proprietary substances in TCW fluids**: The USEPA stated that it is primarily concerned with the characteristics and nature of the actual TCW discharge, i.e., end-of-pipe. Hence, USEPA did not insist that JIP study participants furnish detailed chemical composition data of each TCW fluid used. USEPA stated that if information regarding proprietary substances was needed, the information would be kept confidential.
- **Discharge characterization**: USEPA asked if TCW discharge samples could be collected at the beginning and end of a TCW discharge period. OOC responded that the discharges are generally short in duration (<0.5 to 2 hours; see **Section 4.4.2**). The OOC, however, indicated that this approach would be evaluated and considered for use.
- **Aquatic toxicity**: The following specific elements associated with the evaluation of aquatic toxicity were discussed:
    - **Whole effluent toxicity (WET) testing**: USEPA agreed to the OOC proposal for conducting only the acute WET testing (as stated in the GP) based on OOC's rationale for selecting acute rather than chronic WET testing. Factors that were discussed included the following: GP requirements; exposure frequency, magnitude, and duration; types of constituents; relative sensitivity of the test organisms; and mode of toxicity.
    - **Critical effluent dilution**: Critical effluent dilutions are identified in the GPs: USEPA Region 4 Appendix A; and USEPA Region 6 Appendix D. USEPA requested that a basis for selecting critical effluent dilutions for TCW discharges be presented in the study plan. USEPA indicated that there would be some flexibility to use the produced water critical effluent dilutions provided in the GP, or develop a discharge location-specific effluent dilution with the Cornell Expert Mixing Model (CORMIX). USEPA commented that the OOC should use the critical dilution tables for produced water provided in the GP if the conditions of the TCW discharge were reasonably similar to GP produced water conditions. If the conditions were substantially different, e.g., if the TCW discharge density was substantially higher/lower, then specific CORMIX evaluations might be appropriate.
    - **WET test sample hold times**: The OOC expressed concern about the potential for exceeding WET test sample hold times (36-hours). As discussed with USEPA, samples exceeding the hold times can be analyzed and reported, but the limitations of using such data will be noted in the laboratory report. Approaches for addressing properly preserved samples that are not analyzed within the hold time requirements are presented in this study plan.
    - **Sub-sampling**: The GP does not allow sub-sampling of a WET test sample for compliance analysis. USEPA indicated, however, that sub-sampling of the WET test sample would be acceptable because it is being conducted in support of a study and not GP compliance.
    - **Produced water toxicity data**: USEPA inquired about the potential inclusion of produced water toxicity data in the study, if available. OOC indicated that it will examine the coincidence of TCW discharges and annual produced water toxicity schedules. If feasible, the potential may

exist to report produced water toxicity results that coincide with TCW discharges at the same discharge location.[8]

- **TCW and produced water discharges**: USEPA raised concerns about aquatic toxicity caused by small volumes of TCW discharges that may get mixed in with produced water discharges once a well is back on production. USEPA also asked for greater clarification on the decision criteria used to distinguish TCW discharges from produced water. OOC explained that the study plan will only address TCW discharges that are not commingled with produced water. Hence, this study plan addresses TCW discharges as a separate waste stream.[9]
- **Toxicity associated with well depth**: USEPA expressed concern that well depth could influence the aquatic toxicity of returned TCW discharges. OOC indicated that because the goal of the study is to capture samples from 100 percent (%) of TCW discharges within the first 12 months of sampling, varying well depths will be represented. Hence, the study will document well depths associated with each TCW discharge.

[8] USEPA also raised concerns that the current sampling frequency for produced water discharges might not be high enough. It was agreed that this was a matter for the next GP reissuance rather than something that could be resolved by the study.
[9] Because TCW effluents would upset the treatment system, OOC indicated that TCW effluents are not routed through the produced water treatment system during initial flow-back. Hence, TCW effluents represent a distinct waste stream. Consistent with the GPs, residual TCW constituents become co-mingled with and are treated as produced water.

3.0 TCW Discharge Characteristics

This section presents a general overview of TCW discharge characteristics. Specific topics include a JIP study participant survey of planned TCW discharges; potential sources/types of constituents in TCW discharges; static sheen testing and onsite treatment of TCW discharges; and TCW discharge quality. This information provides a rationale for the sampling and analysis plan (SAP) presented in **Section 4.0**.

3.1 JIP Study Participant Survey

In support of this draft study plan, the OOC prepared and submitted a survey to JIP study participants requesting preliminary baseline information about planned TCW discharges in the GOM.[10] The information provided by JIP study participants in this study plan is subject to change, but will be confirmed before sampling begins. Preliminary information provided by JIP study participants includes lease area; total water column depth (from ocean surface to seafloor); and TCW discharge characteristics, including the following:

- TCW fluid use;
- The use of other chemicals, e.g., corrosion inhibitors;
- Type of onsite treatment, if any, e.g., filtration;
- Discharge configuration, e.g., pipe/hose diameter; and
- Discharge duration and frequency.

Preliminary JIP study participant survey results are provided in **Table 3-1**; survey results are summarized in the following sub-sections and in **Section 4.0**.

3.2 Potential Sources

Potential sources of constituents in TCW discharges include TCW activities; chemical additives; and formation rock. Chemicals derived from these sources can influence both TCW discharge quality and the potential for aquatic toxicity.

3.2.1 TCW Activities

Each TCW activity uses a combination of TCW fluids in the production (or injection) zone for well workovers, treatments, and completions.[11] An overview of TCW fluid categories was presented to USEPA Regions 4 and 6 by the OOC on January 30, 2018. A summary is provided in **Table 3-2**. Based upon information provided by JIP study participants, there is the potential for four categories of TCW fluids to be present in the discharges (Categories I-IV). Details are provided below:

- **Category I fluids**: Category I fluids are typically clear, brine-based fluids used to treat, complete, or work over a well. In general, Category I fluids:
    - Must be compatible with the formation; drill pipe, casing, and tubing subjected to loading conditions (tubular goods); and elastomers;

[10] The information provided by JIP study participants is preliminary and subject to change.

[11] The production zone is a porous rock formation containing the hydrocarbons, either oil or gas, and can be damaged by mud solids and water contained in drilling fluids (USEPA, 1993).

- Can be designed for long-term stability in the wellbore (packer fluids);[12]
- Can be formulated into non-reactive fluid systems;
- Can be formulated into fracturing fluid;
- May be comprised of:
  - Freshwater or seawater;
  - Saltwater brines of appropriate density for well control. Typical salts include sodium chloride, calcium chloride, sodium bromide, and calcium bromide. Salts such as zinc bromide are also used, but not discharged;[13]
- Are clear brine fluids that provide density control without solids; and
- Reduce damage to productive well intervals while still maintaining well control.

- **Category II fluids**: Category II fluids are typically used to remove scale damage; improve permeability of sandstone and carbonate reservoirs; and alleviate near-wellbore damage. Additionally, Category II fluids are:
  - Used as a treating fluid to remediate some form of damage in a well;
  - Inhibited to protect tubular goods and checked for elastomer compatibility; and
  - Typically comprised of organic acids, e.g., acetic and formic acids; inorganic acids, e.g., hydrochloric and hydrofluoric acids; and/or blends of each.
- **Category III fluids**: Category III fluids are fracturing fluids with a Category I fluid as the base component and are used as a treatment fluid. Category III fluid characteristics are summarized below:
  - Polymers such as guar are used to give the fluid viscosity;
  - Cross-linkers, e.g., potassium hydroxide and borate salts, are used to create a gel-like consistency:
    - Supporting additives are used to improve the cross-link function, or improve performance of the fracturing fluid:
      - Buffers maintain favorable fracturing fluid pH to stabilize the cross-link;
      - Surfactants improve wettability of the reservoir and fluid recovery; and
      - Breakers ensure that the cross-link breaks as designed.
  - Contain less than 5% additives. A typical fracturing fluid formulation is presented below:

Additive Name	Units	Quantity
Fresh Water	Gallons	985
Salt (3% solution of KCl)	Pounds	250

[12] Packer fluids, i.e., low solids fluids between the packer, production string and well casing, are considered to be workover fluids and must meet the effluent requirements imposed on workover fluids.
[13] Zinc bromide has a higher aquatic hazard than the other salts.

Additive Name	Units	Quantity
Polymer-guar	Pounds	20-40
Buffer	Gallons	1-5
Surfactant	Gallons	1-5
Cross-linker	Gallons	1-3
Breaker	Pounds	1-2

- Typical pumped volumes depend on the type of well and the specific operation being performed. Representative pumped volumes (barrels [bbls]/stage) are presented below for consolidated, e.g., solid bedrock and unconsolidated formations, e.g., loose materials ranging from clay to gravel. Typical recovery/reversed volumes range from 10-30%; the remainder remains in the formation:

Frac Stage Type	Typical Volume Pumped (bbls/stage)	
	Unconsolidated Formation (Frac Pack)	Consolidated Formation (Frac)
Misc. Fluids/Workstring Volumes	1,500-7,000	1,500-7,000
Mini-Frac	500-700	500-700
Mini-Frac Flush	500-800	500-800
Main Treatment	1,500-2,500	5,000-7,000
Main Treatment Flush	500-800	500-800

- **Category IV fluids**: Category IV fluids can be classified as a TCW fluid depending on how they are used. Category IV fluids involve the use of hydrocarbons and base oils as described below:
  - Use of hydrocarbon-based fluids in TCW fluids is infrequent and generally restricted to the removal of waxes and asphaltenes from the wellbore and/or sand-face.
  - Some hydrocarbons can be gelled to act as fracturing fluids, but that only occurs when water-based fluids are damaging to the reservoir. Hydrocarbon use is not common.
  - Gelled hydrocarbons may also be used as packer fluids to (1) control convective heat transfer in wells that have high bottom well-hole temperatures, or (2) high flow rates that create a high-temperature environment that could damage ancillary equipment.
  - Base oils (such as lubricant oils) comprised of insoluble aliphatic hydrocarbons can be used to perform negative pressure testing for regulatory compliance.

3.2.2 Chemical Additives

In addition to their use in TCW fluids, chemical additives can be used to control pH and alkalinity; control calcium buildup in equipment; control biological growth; reduce corrosion potential; reduce foaming action; act as de-emulsifiers; and reduce the relationship between viscosity and solids concentration. Based on information provided by JIP study participants, the following could be present in TCW discharges: TCW fluid additives; corrosion inhibitors; de-emulsifiers; surfactants; de-foamers; and biocides. Constituents that can be present in common types of chemical additives are provided below (California Council on Science and Technology [CCST], 2014):

Additive Type	Examples of Chemicals Used
Proppants	Sand (sintered bauxite; zirconium oxide; ceramic beads)
Acids	Hydrochloric acid
Breakers	Peroxydisulfates
Biocides	Glutaraldehyde; 2,2-dibromo-3-nitrilopropionamide
pH adjustment	Sodium or potassium carbonate; acetic acid
Clay stabilizer	Salts such as tetramethyl ammonium chloride
Corrosion inhibitors	Methanol; ammonium bisulfate
Cross-linkers	Potassium hydroxide
Scale inhibitors	Ammonium chloride; ethylene glycol
Surfactants	Ethoxylated alcohol
Gelling agent	Guar gum; petroleum distillates
Solvent	Methanol; isopropanol; various aromatic hydrocarbons, e.g. toluene, xylenes, aromatic solvents
Friction reducer	Sodium acrylate-acrylamide copolymer; polyacrylamide (PAM); petroleum distillates

3.2.3 Formation Rock

Formation rock can potentially contribute trace metals and organics mobilized by the action of TCW constituents to initial well flow-back (Argonne National Laboratory, 2016). Well flow-back refers to the process of allowing fluids to flow from the well following a treatment, either in preparation for a subsequent phase of treatment or in preparation for cleanup, and returning the well to production. Variability in constituents across discharge structures is also expected due to differences in formation rock, in addition to (1) the disposition of TCW fluids resulting from fate processes, e.g., temperature, pressure, dilution, adsorption; and (2) contributions to flow-back from the treated formation rock. It can also be expected that the chemical composition of treated well flow-back is likely to differ from injected "neat" TCW fluid and unaltered produced water from the formation rock.

3.3 TCW Discharge Quality

This sub-section presents an overview of TCW discharge quality. Topics that are discussed include (1) onsite treatment of TCW discharges; (2) static sheen testing; and (3) constituents potentially present in TCW discharges.

3.3.1 Treatment of TCW Discharges

Generally, TCW fluid and formation water discharges can be treated as a separate stream. JIP study participants indicate that the treatment of the comingled TCW fluids and formation water is conducted at some discharge locations, but not all. Treatment generally is intended to reduce oil and grease, and to neutralize pH before discharge to surface waters (USEPA, 2009). A typical well flow-back process flow diagram for oil and grease removal from TCW discharges is presented in **Figure 3-1**.[14]

To achieve the required removal of oil and grease, a treatment system can include the transfer of TCW discharges to an oil/water separator (OWS). Separated oil is pumped to an oil surge tank via a poly-diaphragm pump and the treated discharge from the OWS is sent to total suspended solids (TSS) filtration. After filtration, the water is polished for residual organics and dissolved oil removal via carbon adsorption, i.e., tertiary treatment with walnut shell filters or other media types and discharged to GOM surface waters.

[14] The well flow-back process flow diagram was provided by JIP study participant and OOC technical review team leader Jim Floyd (Chevron). The diagram was developed by Siemens Energy, Inc.

This type of treatment is effective at removing metals; hydrocarbons; acid, base and neutral compounds; and high molecular (HMW) weight organics from the discharge (Bansode et al., 2003; Igwe, Saadi, and Ngene, 2013). Furthermore, filtration provides additional reductions in TSS and biochemical oxygen demand (BOD) (Quach-Cu et al., 2018).

3.3.2 Static Sheen Test for Free Oil

Based on JIP study participant feedback, samples of all TCW discharges are subjected to a static sheen test (USEPA Method 1617), which is a qualitative test used to demonstrate compliance with the GP requirement for "no discharge of free oil".[15] All static sheen test regulations are based on the premise that nearly all observers can recognize the appearance of an oily sheen on a water surface (Weintritt, Qaisieh, and Otto, 1993).

With the static sheen test, samples of the TCW discharge are dispersed within a sample of ambient receiving seawater. After one hour, observations are made as to the presence of sheen, iridescence, gloss, or increased reflectance on the surface of the seawater. The occurrence of any of these visual observations indicates that the TCW discharge contains free oil, and cannot be discharged to GOM surface waters. If samples of the TCW discharge do not pass the static sheen test, JIP study participants will use an alternative method for managing TCW discharges other than ocean disposal.

3.3.3 Potential Constituents in TCW Discharges

The GP requires that TCW discharge quality conforms to standards for free oil; oil and grease; and priority pollutants (PP).[16] Generally, the composition and concentration of constituents in final TCW discharges will vary with the type and amount of chemicals used; the type of onsite treatment (if any); formation rock; and fate processes. Constituents that could potentially be present in TCW discharges likely fall under one of the following three categories:

- **Organics**: If onsite tertiary treatment is used (as described above in Section 3.3.1), organics will likely not be detected in the final discharge. If this type of treatment is not used, however, organic constituents present in the discharge could include semi-volatile organic compounds (SVOCs), e.g., 16 parent polycyclic aromatic hydrocarbons (PAHs); and volatile organic compounds (VOCs), e.g., benzene, toluene, ethylbenzene, and xylenes (BTEX).
- **Metals:** Metals, e.g., arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, thallium, and zinc could potentially be present in TCW discharges.
- **Ions**: Ions can pass through an onsite treatment system and will be present in the discharge. As previously discussed, salt (ion) mixtures commonly found in TCW fluids include ionic salts such as sodium chloride, calcium chloride, sodium bromide, and calcium bromide. The mixture of individual ions can contribute to elevated total dissolved solids (TDS).

[15] "Free oil" refers to any oil in a waste stream that produces a sheen covering 50% or more of the surface of a pan with a surface area of 1,000 sq. cm. (Weintritt, Qaisieh, and Otto, 1993).

[16] As described in the GP, for TCW discharges, the release of Priority Pollutants to GOM surface waters is prohibited except in trace amounts.

3.3.4 Discharge Mixing

TCW discharges represent a minor source of chemical discharges to ocean waters because of the relatively low volume of the TCW discharge and nearly instantaneous mixing with seawater (Argonne National Laboratory, 2016). Although fate processes such as abiotic transformation and biodegradation may reduce constituent concentrations in seawater, no GP-specified methods to account for these processes are available. Hence, the role of dilution due to mixing effects is addressed in this sub-section.

The GPs authorize a 100-meter (m) mixing zone measured laterally from the end-of-pipe. Acute whole effluent toxicity (WET) and laboratory analytical testing will be conducted on simulated TCW effluent dilutions at the edge of the 100-m mixing zone. To comply with the GPs, the acute WET test effect concentration expressed in terms of % TCW effluent dilution must be equal to or greater than the critical effluent dilution (%) specified in the GP.

As defined, the critical effluent dilution reflects mixing and is obtained from a model-predicted effluent concentration at the edge of the mixing zone. Critical effluent dilutions are provided in the GPs. As discussed in Section 4.0, the critical effluent dilution will be selected from the GPs based on (1) depth difference between the discharge pipe and the seafloor, (2) discharge rate (bbls/day), and (3) discharge pipe diameter (in.).

4.0 Sampling and Analysis Plan

This study plan section presents the sampling and analysis plan (SAP). The SAP identifies the study data quality objectives (DQOs), presents the technical approach, and was prepared consistent with the following Federal technical guidance:

- USEPA. 2017a. Region 4 SESDPROC-306-R4: Wastewater Sampling.
- USEPA. 2014. Sampling and Analysis Plan Guidance and Template. Ver. 4, General Projects.
- USEPA. 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process.
- USEPA. 2000. Method Guidance and Recommendations for Whole Effluent Toxicity Testing (40 CFR Part 136).

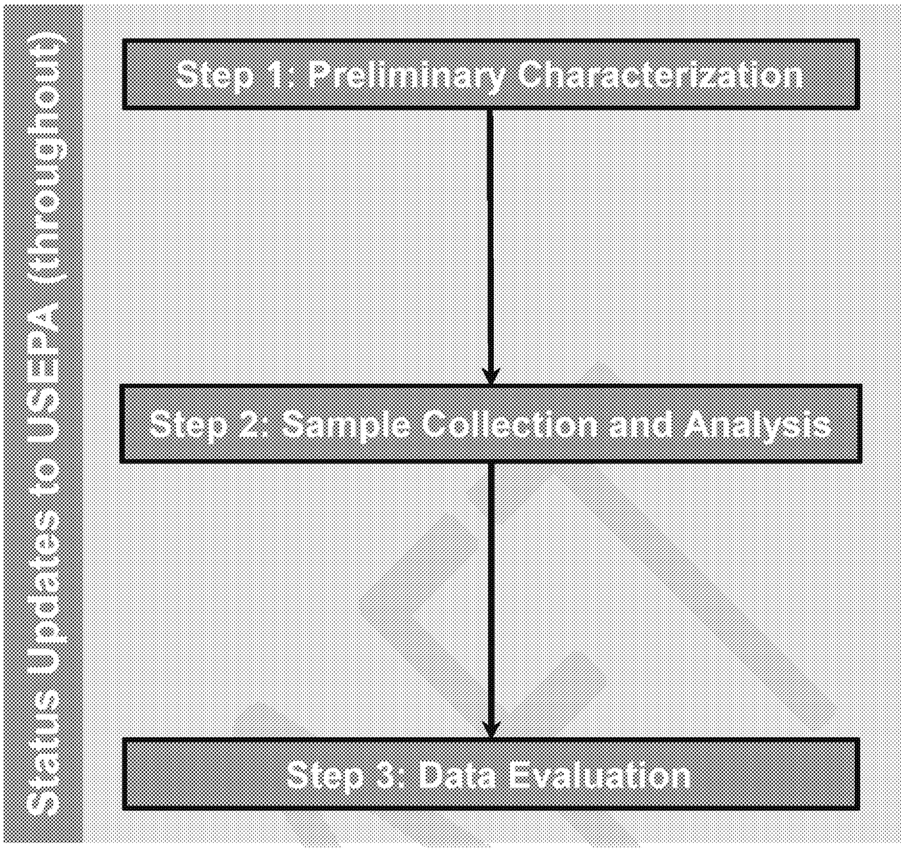
4.1 Data Quality Objectives

DQOs are qualitative and quantitative statements that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors (USEPA, 2006). DQOs are provided in **Table 4-1**. JIP study plan components are consistent with the USEPA (2006) seven-step DQO process:

- Step 1. State the problem;
- Step 2. Identify study goals;
- Step 3. Identify data and information needed;
- Step 4. Define study boundaries;
- Step 5. Develop the analytic approach and logic for drawing conclusions;
- Step 6. Specify performance or acceptance criteria including probability limits; and
- Step 7. Develop the plan for obtaining data.

4.2 Technical Approach

The technical approach presented in this sub-section consists of the three steps discussed with USEPA in September 2018: (1) preliminary characterization; (2) sample collection and analysis; and (3) data evaluation. The proposed methods and materials presented in the SAP will meet GOM NPDES GP requirements and JIP study DQOs. Transparency and communication are critical throughout the JIP study. Hence, communications with USEPA and other stakeholders, i.e., status reports, will occur at regularly scheduled intervals and at significant milestones (see **Section 5.0** and **Section 6.0**). The overall SAP technical approach is illustrated below:



4.3 Step 1: Preliminary Characterization

The Step 1 preliminary characterization will consist of a review for the three key constituent groups in TCW fluids (organics, metals, and ions) and a synthesis of the information. Step 1 will address the following study questions:

- What constituents are currently used in TCW fluids?
- What are their general aquatic hazard characteristics?

The proposed review and synthesis will address GP requirements for characterizing constituents in TCW fluids by (1) identifying the common names and chemical parameters for dominant TCW fluid additives, and (2) assessing their influence on the chemical composition and aquatic toxicity of TCW discharges.

4.3.1 Constituents in TCW Fluids

The goal of this assessment is to identify and better characterize the likely and lesser-known constituents currently used in TCW fluids. Two sources of information will be used including (1) JIP study participants, and (2) publicly available sources:

- **JIP study participants**: JIP study participants will be the primary source of information regarding TCW fluid use at the discharge structure including type, e.g., Category I-IV. The preliminary information on TCW fluid use provided in Table 3-1 will be confirmed with JIP study participants.
- **Publicly available sources**: Relevant information from publicly available sources will also be reviewed. Publicly available data sources may include, but are not limited to the following:

- Safety data sheets (SDSs): SDSs include chemical composition and will be used to identify general composition of TCW fluid additives and aquatic hazard data, where provided;
- Published reports and studies of offshore O&G activities; and
- Internet databases, e.g., Organization for Economic Co-operation and Development (OECD) eChemPortal; European Chemicals Agency (ECHA) Registered Substances database; PubChem (Kim et al., 2016); USEPA ECOTOXicology knowledgebase (ECOTOX); USEPA Estimation Programs Interface Suite (EPISuite) software.

4.3.2 Data Evaluation and Summary

Dominant constituents likely to be present in TCW fluids will be listed and a narrative summary will be prepared for each constituent group. Aquatic hazard data will also be compiled and summarized.

4.4 Step 2: Sample Collection and Analysis

Step 2 will involve TCW discharge sample collection, acute WET testing, and laboratory analysis of selected constituents. The intent of the laboratory analysis is to provide data, for a practicable list of constituents, to support a characterization of possible associations between constituents and acute toxicity (if observed). Step 2 will address the following study questions:

- How are TCW discharges typically handled and their discharge to GOM surface waters managed?
- What is the typical chemical composition of TCW discharges?
- What are the estimated concentrations of constituents in GOM surface waters at the critical effluent dilution, i.e., the concentration predicted to exist in the discharge plume at the edge of the 100 meter (m) mixing zone?
- What is the potential for the constituents in TCW discharges to cause acute aquatic toxicity at the critical effluent dilution?

The proposed characterizations will also address GP requirements for providing greater detail on the characteristics of the TCW discharges, including chemical composition and variability in chemical composition and aquatic toxicity. The following sub-sections describe the GOM study area; identify anticipated TCW discharge sample locations and sample collection methods; describe proposed laboratory analyses; and summarize general quality assurance/quality control (QA/QC) procedures.

4.4.1 GOM Study Area

The GOM study area includes the central and western planning areas, which generate approximately 97% of all outer continental shelf (OCS) O&G production. The 671,875 square mile (mi^2) GOM is bordered by Cuba on the southeast; Mexico on the south and southwest; and the U.S. Gulf Coast on the west, north, and east (USEPA, 2017b) (**Figure 4-1**). GOM surface water currents range from 0.1 to 3 inches per second (in/s) (USEPA, 2017b). Surface water temperatures in August range from 84-86°F; in January, surface water temperatures range from 77°F in the southeastern GOM to 57-59°F along the shallow northern coastal estuaries (USEPA, 2017b). The salinity of GOM surface waters ranges from 36 to 37 parts per thousand (‰). Average water column depth is approximately 5,000 feet (ft.), with a maximum water column depth of approximately 14,000 ft. within the Sigsbee abyssal plain.

4.4.2 Planned TCW Discharges

Based on preliminary information provided by JIP study participants, the locations of tentatively planned TCW discharges are known for the first, 12-month consecutive period (Year 1 [2019] and Year 2 [2020]).[17] The discharges are located within the western and central planning areas (**Figure 4-2**). Most of the planned discharges will occur within USEPA Region 6, with three TCW discharges located along the jurisdictional boundary between USEPA Regions 4 and 6.[18] A chronological listing of the planned TCW discharges for Years 1 and 2 is presented in **Table 4-2**. General characteristics of the planned TCW discharges are summarized below (as previously discussed, preliminary details of the TCW discharges are provided in Table 3-1):

- Most of the selected TCW discharges are located in deep waters, with three discharges located in shallow waters.[19] Arithmetic mean water column depth for discharge locations with planned TCW discharges is 5,051 ft., with a minimum of 375 feet and a maximum of 9,558 ft.
- Generally, TCW discharges occur through either a pipe or hose with diameters ranging from 2 to 16 inches.[20] The end-of-pipe may range from 20 ft. above to 99 ft. below the water surface.
- TCW discharges will be intermittent and of short duration, ranging from <0.5 to 2 hours. Discharges will only occur after passing a static sheen test for free oil.
- The frequency of the discharges can be (1) once per well operation; (2) weekly; (3) monthly; and (4) quarterly.

4.4.3 Sample Collection Overview

Based upon discussions with USEPA in September 2018, sample collection can begin before formal USEPA approval of the study plan is received. TCW discharge samples will be evaluated for:

- Acute 48-hour WET testing; and
- Chemical analysis.

During Year 1, acute 48-hour WET testing and chemical analysis will be conducted on samples collected at each planned TCW discharge location. In Year 2, an adaptive approach will be used for sampling and analysis of the planned discharges based on

[17] This information is subject to change as planning details evolve.

[18] USEPA Region 6 jurisdiction covers the Western planning area and much of the Central planning area. USEPA Region 4 jurisdiction within the GOM extends from the eastern edge of the Central planning area to the Eastern planning area (west coast of Florida). As described in the NPDES GP, the lease areas under Region 6 that begin in the Central planning area include: Chandeleur; Chandeleur East; Breton Sound; Main Pass; Main Pass South and East; Viosca Knoll, but only those blocks under Main Pass South and East (the Viosca Knoll blocks between Main Pass and Mobile are under USEPA Region 4 jurisdiction); South Pass; South Pass South and East; West Delta; West Delta South; Mississippi Canyon; Atwater Valley; Lund; and Lund South.

[19] Deep water within the Gulf of Mexico is defined by the 1,000-foot isobath. Water depths <1,000 ft. are considered shallow. Currently, three discharges are planned in shallow water. Two of the three discharges have known water column depths (375 and 390 feet).

[20] In certain instances, the discharge structure consists of a non-circular, multi-slot discharge with an equivalent area of 23 in.

lessons and findings from Year 1 (see **Section 4.4.5**). **Appendix A** includes the TCW discharge sampling Standard Operating Procedure (SOP). An overview of sample collection is presented below:

- **Sample schedule**: Sampling will occur in calendar years 2019 and 2020; it is anticipated that sampling will begin in the second quarter of 2019, pending preliminary USEPA review of this study plan. Based on the results collected in the first 12 months, the suggested approach can be refined, as necessary. The anticipated duration of sample collection and laboratory testing is presented below:

JIP Study Component	Anticipated Duration
Sample Collection	Approximately 15-20 minutes per sample event.
WET Test	WET test duration is 48 hours; turnaround time (TAT) is typically 1 month from the time that samples are received. Draft WET test statistics can be provided by the laboratory on a rush TAT basis, as necessary.
Analytical	The laboratory TAT is typically 1 month from the time that samples are received.

- **Sample location**: Discharge sample locations will be selected based on representativeness, safety, and accessibility; all samples will be collected on the Platform/vessel/discharge structure. Almost all discharge locations have a discharge valve or sample port on the overboard discharge line to sample discharges.

  Consistent with the NPDES GP, the sampling location will be situated after final treatment (if existing) and before discharge to surface waters. A typical sample location from the overboard discharge line with final treatment is depicted in **Figure 4-3**. In those instances where final treatment is not present, samples can (for example) be collected from the oil and grease sample location. Typical sample locations for discharges without treatment including "pits" and the rig fluid system are depicted in **Figure 4-4**.[21] Consistent with USEPA (2017), the following general information may be obtained (where available and applicable) in support of the sampling effort:

  - Process flow diagrams and/or written descriptions of the onsite treatment system.
  - Process control information on the onsite treatment process.

- **Sample collection methodology**: As specified in the GP, TCW discharge samples can be collected as either a grab sample or a 24-hour composite sample.[22] To meet GP requirements and JIP study DQOs, representative TCW discharge samples will be collected as a grab sample at the beginning of the discharge after purging the discharge line, if applicable. As defined in the GP, a grab sample is an "individual sample collected in less than 15 minutes". The sample collection rationale and methodology are presented below:

  - <u>Rationale</u>: The rationale for selecting a grab sample at the beginning of the discharge is presented below:

    - *Constituent concentrations*: It is assumed that constituent concentrations will likely be highest at the beginning of the TCW

[21] The typical TCW Return Path diagram presented in Figure 4-4 was provided by Shell.
[22] A 24-hour composite sample consisting of the arithmetic average of the results of several grab samples collected at even intervals during a period of 24-hours or less.

discharge (and after flushing the overboard discharge line). Hence, collecting a TCW discharge sample at the beginning of the discharge is deemed conservative.

- *Standardization*: The grab sample will be collected at the beginning of the discharge for all sampled discharge locations. By standardizing sample collection methodology, the proposed approach will (1) take account of a potential decrease in constituent concentrations over the duration of the discharge, and (2) minimize uncertainty in analytical data interpretation. This could not be achieved if sample collection methodology varied across discharge locations.
- *Duration of discharge*: TCW discharge duration is anticipated to be short (<0.5 – 2 hours). Hence, a grab sample is likely to be representative.

As previously discussed, OOC agreed to evaluate the USEPA request that samples be collected at the beginning and end of the discharge. To respond to USEPA's comment about the representativeness of this approach, the OOC may evaluate collecting a sample at the beginning and at the end of a longer duration TCW discharge, and compare the results, if feasible.

- Sample collection methodology: A summary of the proposed sample collection methodology is provided below:
  - Grab samples will be collected from discharge valves/sample ports, or other representative locations, e.g., oil and grease sample location. Manual sampling is normally used for collecting grab samples. Sample volume will be sufficient for both the WET and analytical testing.
  - QA/QC samples will likely consist of a field blank; trip blank; and a matrix spike/matrix spike duplicate (MS/MSD). This is discussed further in the quality assurance project plan (QAPP) (**Appendix B**).

- **Sample identification:** Sample identification is discussed in the SOP (Appendix A) and the QAPP (Appendix B); a summary is provided below:
  - All collected samples will be labeled clearly and precisely for proper identification in the field and for tracking in the laboratory. The samples will have pre-assigned, identifiable, and unique numbers. At a minimum, the sample labels will contain the following information: sample number; date of collection; analytical parameter(s); and method of preservation. Every sample will be assigned a unique sample number and will include:

"JIP Study – Area – Block – American Petroleum Institute (API) Well Number – TCW Discharge – Sample Event Number"

- **Sample shipping**: Details regarding sample shipping are provided in the SOP and the QAPP; an overview is provided below:
  - Sample coolers will be delivered to shore bases/heliports in close proximity to the ecotoxicology laboratory (Environmental Enterprises USA, Inc. or "EEUSA") (**Figure 4-5**). The WET test laboratory will pick up

samples and drop off empty sample kits at the shore bases Monday through Friday. Ideally sample drop-off would be coordinated with Operator routine transportation, i.e., a shift-change. If this is not practical, the samples may be "hot-shot" to meet sample hold time requirements. Shore bases and WET test laboratory sample kit drop-off/sample pickup times are described in the SOP.

- EEUSA will pick the samples up from shore bases or receive the samples from parcel carrier. EEUSA will prepare sub-samples at the critical effluent dilution concentration at their laboratory by dilution with artificial seawater. EEUSA will ship the samples to the analytical laboratory (Element Materials Technology or "EMTL"). EMTL will (where applicable) conduct the filtering of samples for dissolved metals analysis consistent with the analytical method. Contact information for the selected laboratories is provided below:

Laboratory	Abbreviation	Contact Information	Responsibility
Environmental Enterprises USA, Inc.	EEUSA	David Daniel President/Laboratory Manager TEL: 800 966 2788 58485 Pearl Acres Rd. Slidell, LA 70461 Website: http://www.eeusa.com/	WET testing; preparation of samples at the critical effluent dilution for chemical analysis
Element Materials Technology Lafayette	EMTL	Cristina Thibeaux Project Manager TEL: (337) 235-0483 2417 W. Pinhook Road Lafayette, LA 70508-3344 Website: www.element.com	Chemical analysis of prepared samples

4.4.4 Acute 48-hour WET Test Samples

Acute WET testing will determine if the TCW discharge is likely to cause acute toxicity towards aquatic biota at the critical effluent dilution. General WET test considerations are presented below:

- **WET test type**: An acute, static renewal 48-hour toxicity test will be conducted consistent with the GP and the USEPA (2002) guidance *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*; EPA-821-R-02-012.[23] The test organisms will be exposed to the test medium for the duration of the test (48 hours).
- **WET test sample collection**: The samples will be contained in high density polyethylene (HDPE) containers provided by EEUSA. The samples will have zero headspace; be kept cool to <6°C; and will be shipped to EEUSA consistent with the SOP and QAPP. WET test hold time is 36 hours: tests must be initiated within 36 hours of sample collection. If sample volume is insufficient for renewal due to problems encountered during sample collection, the WET test laboratory can alter the required dilution series, the volume of sample per replicate, or the

[23] Discharges within USEPA Region 4 will be required to conduct chronic toxicity testing for discharges >4 consecutive days per the permit requirements for that region. Because the planned discharges will be <4 days, the proposed acute toxicity testing is consistent with GP requirements.

replicates per treatment to achieve the required sample renewal volume. Any deviations will be noted in the WET laboratory report.

- **WET test organisms**: Consistent with the GPs and the USEPA methodology, the acute test will be conducted for each TCW discharge sample with *Americamysis bahia* (mysid shrimp) and *Menidia beryllina* (inland silverside minnow).[24] A minimum of five (5) replicates with eight (8) organisms per replicate will be used in the control and in each effluent dilution of this test.

- **WET test effluent dilution series**: WET testing will be evaluated across an appropriate % effluent dilution series consistent with the GPs and USEPA (2000) guidance. The effluent dilution series, i.e., the number and spacing of test concentrations for WET tests, is critical for producing reliable and precise WET test results, including the precision of effect concentrations (USEPA, 2000).

  Consistent with the GPs, a total of six effluent dilutions will be used including a laboratory control (0% effluent); a critical effluent dilution, and two effluent dilutions identified above and below the critical effluent dilution.[25] The critical effluent dilution represents the dilution of the discharge after initial dilution and secondary mixing at the edge of the 100 m effluent mixing zone.[26] Critical effluent dilutions will be selected from the GPs in accordance with the applicable USEPA regulatory jurisdiction. For example, if the discharge sample is collected in USEPA Region 6, the critical effluent dilutions will be obtained from Appendix D of the Region 6 GP. If the discharge sample is collected within USEPA Region 4, then the critical effluent dilutions will be selected from the applicable tables in Appendix A of the Region 4 GP.[27] The critical effluent dilution for a given discharge will be selected based upon discharge rate (bbls/day); vertical difference between the discharge pipe and seafloor (m); and pipe diameter (in.).

- **WET test endpoints:** Consistent with the GPs, two WET test endpoints will be reported for lethality including a 48-hour no observed effect concentration (NOEC) (USEPA Region 6 GP) and where possible, a 50% lethal concentration (LC50) (USEPA Region 4 GP) for each test organism.[28] The NOEC is defined in the USEPA Region 6 GP as the greatest effluent dilution which does not result in lethality that is statistically different from the control (0% effluent) at the 95% confidence level (probability [p]=0.05). Generally, the LC50 is defined as the

[24] The current genus and species for the mysid shrimp is *Americamysis bahia* (Price et al., 1994). The GP and USEPA (2002) whole effluent toxicity (WET) test methodology, however, use the genus and species *Mysidopsis bahia*. Consistent with the current nomenclature, *A. bahia* will be used throughout the JIP study.
[25] The WET method manuals recommend a dilution geometric ratio (factor) of 0.5 for preparing WET test concentrations, which represents a lower limit on the dilution factor (USEPA, 2000). The following acute WET test dilution factors are specified in the USEPA Region 4 GP for TCW discharges <4 days: lab control (0); 0.25; 0.5; the critical dilution; 2; and 4. Generally, the selected dilution factors will be reviewed with EEUSA before assigning a dilution series.
[26] As discussed in the GPs, the critical effluent dilution is based on the highest monthly average discharge rate for the three months prior to the month in which the test sample is collected, discharge pipe diameter, and water depth between the discharge pipe and the bottom (seabed).
[27] The produced water critical effluent dilutions identified in the GPs can be applied to the TCW discharges because TCW discharges are not expected to behave differently in ambient seawater than produced water discharges. That is, TCW discharge densities are consistent with the densities cited in the GPs for produced water.
[28] USEPA Region 4 requires the LC50 to calculate the acute critical dilution (ACD). It may not be possible to calculate an exact LC50 because toxicity may not be observed. In this case, the LC50 would be reported as greater than the maximum effluent dilution.

effluent dilution that results in the lethality of 50% of the test organisms within the 48-hour test period.

The LC50 is generated with point estimation techniques; the NOEC is generated with hypothesis testing techniques. The NOEC and LC50 will be estimated with the ToxCalc™ software or equivalent.[29] If deemed necessary, EEUSA can report multiple WET test endpoints based on hypothesis testing and point estimation techniques.

Consistent with the USEPA Region 6 GP, if the WET test NOEC is at or above the critical effluent dilution, acute aquatic toxicity is not expected for GOM aquatic biota at the edge of the mixing zone. Consistent with the USEPA Region 4 GP, if the percent survival of the test organism is ≥90% at the critical effluent dilution and all lower dilutions, the WET test will be considered passing, i.e., LC50>critical dilution.

- **WET test acceptability criteria**: WET test acceptability criteria (TAC) will be consistent with the GPs and USEPA WET test method EPA-821-R-02-012.
- **Positive control (reference toxicant tests)**: Reference toxicant tests demonstrate the ability of the lab to (1) obtain consistent results with the test method, and (2) evaluate the overall health and sensitivity of test organisms over time. Hence, the review of a given TCW discharge WET test should include review of the associated reference toxicant test and current control chart quality control. An out-of-control reference toxicant test result does not, however, necessarily invalidate associated test results (USEPA, 2002). The lab will indicate if the reference toxicant test was conducted according to the specified frequency recommended by the method, e.g., monthly. Control charts or other variability and test performance measures, e.g., minimum significant difference, standard deviation, CV of control responses, or average control response, also may be useful for assessing test quality (USEPA, 2002) and will be reviewed.

4.4.5 Samples for Chemical Analysis

Chemical analyses will only be conducted on samples prepared by EEUSA at the critical effluent dilution. This approach will minimize uncertainty associated with measuring constituents in samples of 100% TCW discharge and extrapolating to the critical effluent dilution. Detailed lists of chemical parameters are not provided in this study plan but will be developed early in the sampling phase of the study. The selection of chemical parameters will be based on expected constituents in TCW discharges with published USEPA acute toxicological information for the test species. The chemical parameters ultimately selected for evaluation will likely be representative of the three (previously discussed) constituent groups. An overview is presented below:

- **Overview**: Samples for chemical analysis will be collected in calendar years 2019 and 2020, consistent with the GP requirements. It is proposed that a representative suite of analyses be performed during the first consecutive 12 months of the study. In this manner, Year 1 will serve as a "baseline" year by providing analytical data across all sampled discharges. The Year 1 analytical data sets may be used to assess spatial and other patterns in key characteristics, e.g., toxicity and constituent concentrations that could be explained by TCW fluid

[29] ToxCalc™ is a complete statistical package specifically designed for environmental toxicity testing. The WET test laboratory may also use the CETIS software package.

use, well depth, formation rock, or other factors. Ultimately, the Year 1 findings, including detected constituents and WET test results, will be used to refine the Year 2 laboratory analyses with an adaptive approach (**Figure 4-6**). For example, samples that exhibit toxicity in Year 2 will be analyzed for the full suite of selected laboratory constituents; samples that do not exhibit acute toxicity will not be analyzed. Other Year 2 refinements may be necessary, however, based upon the 2019 findings.

- **Selected constituents**: Flexibility to select constituents for study is desired. Hence, the specific selected constituents are not presented in this study plan. Generally, constituents that are being considered for analysis include: organics with a known potential to cause aquatic toxicity, e.g., 16 Priority Pollutant PAHs; total/dissolved Priority Pollutant metals with acute saltwater aquatic toxicity data and/or promulgated aquatic life data; and select ions (cations/anions).[30] Water quality parameters that influence aquatic toxicity/bioavailability may also be measured, e.g., alkalinity, hardness, pH, dissolved organic carbon (DOC), ammonia, and hydrogen sulfide.
- **Constituent concentrations**: Concentrations of the selected constituents will be measured at the critical effluent dilution by EMTL.

4.5 Step 3: Data Evaluation

The Step 3 data evaluations will consist of (1) a qualitative, acute toxicity screening and (2) a source assessment if acute toxicity is observed. Ultimately, the Step 3 data evaluations will be used to place the laboratory analytical results into a meaningful context and help assess potential sources of toxicity, as warranted.

4.5.1 Acute Toxicity Screening

The acute toxicity screening will assess the potential for acute toxicity towards *A. bahia* and *M. beryllina* by (1) complementing the absence of acute toxicity for a given TCW discharge (negative evidence); and (2) identifying constituents potentially associated with acute toxicity, if observed. Only constituents detected above the laboratory practical quantitation limit (PQL) with a USEPA published species-specific acute saltwater effects benchmark and/or aquatic life criterion will be evaluated. Sources of acute effects benchmarks and aquatic life criteria are discussed below:

- **Acute species-specific effects benchmarks** will be identified for *A. bahia* and *M. beryllina*. Potential effects benchmarks will be based on USEPA-reviewed ecotoxicological data including species mean acute values (SMAVs) or genus mean acute values (GMAVs). Consistent with USEPA methodology, dividing the SMAV (or GMAV) by 2 can be used to estimate acute toxicity effects benchmarks for a constituent. Additional literature used by USEPA in support of benchmark derivation may also be consulted. A hierarchy of acceptable sources of species-specific aquatic toxicity data for review may include (but is not limited to) the following:
    - USEPA. 2003. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures: Appendix C. Summary of Data on the Acute Toxicity of

[30] Due to the nature of the discharge and mixing of toxicity test samples during sample preparation, the loss of VOCs through volatilization may occur. Hence, VOCs will not be analyzed in TCW discharge samples.

PAHs to Freshwater and Saltwater Species and the Derivation of Genus Mean Acute Values;

  - USEPA. 2016. Draft Aquatic Life Ambient Estuarine/Marine Water Quality Criteria for Copper: Appendix A. Acceptable Estuarine/Marine Acute Toxicity Data;
  - USEPA ECOTOX;
  - USEPA-reviewed ecotoxicological literature; and
  - The OECD eChemPortal.

- **Published acute saltwater aquatic life criteria** will only be used if reliable, species-specific effects benchmarks are not identified. The acute aquatic life criteria are intended to be protective of $\geq$95% of the aquatic community. The evaluation rationale will be that if the measured constituent concentration is less than the aquatic life criteria, then the constituent is likely not the cause of any measured toxicity. A hierarchy of acceptable sources of aquatic life criteria may include (but is not limited to) the following:
  - USEPA. 2018a. National Recommended Water Quality Criteria - Aquatic Life Criteria Table: Saltwater Criterion Maximum Concentration (CMC) (Acute); and
  - USEPA. 2018b. Region 4 Surface Water Screening Values for Hazardous Waste Sites: Saltwater (Acute).

The approach presented below is an example of how data may be used to qualitatively assess the association between a constituent and acute toxicity at the critical dilution:

- The measured constituent concentration at the critical dilution ($C_{crit.dil.}$) may be used to assess the potential for acute aquatic toxicity. For example, a comparison of $C_{crit.dil.}$ with the acute species-specific effects benchmark and/or aquatic life criterion may be conducted. The potential for acute aquatic toxicity may be expressed with a hazard quotient (HQ) where:

$$HQ = \frac{C_{crit.dil.}}{Effects\ Benchmark\ or\ Aquatic\ Life\ Criterion}; \text{ and}$$

  HQ<1: If $C_{crit.dil.}$ is below the species-specific effects benchmark, then acute aquatic toxicity to *A. bahia* and *M. beryllina* is not probable. If there are no species-specific acute aquatic toxicity data, but $C_{crit.dil.}$ is below the aquatic life criterion, then it may be concluded that the constituent is likely not associated with acute toxicity to *A. bahia* and *M. beryllina*.

  HQ$\geq$1: If $C_{crit.dil.}$ is greater than/equal to the acute species-specific effects benchmark (or aquatic life criterion if no species-specific effects benchmark is available), this may indicate that the constituent contributes to measured toxicity at the critical dilution. Although the constituent will be identified as a possible contributor to toxicity, no confirmatory testing is planned.

4.5.2 Assessing Potential Sources of Acute Toxicity

If acute toxicity is observed, a follow-up assessment may be conducted to identify potential sources of the toxicity. This will be a collaborative effort with the Operator of the affected discharge. The assessment may start with the identification of constituents with an acute HQ$\geq$1. Constituents with an HQ$\geq$1 could point towards potential sources, e.g., TCW fluids, chemical additives, or an operational upset. Additional chemical analysis and acute WET testing are not proposed. Hence, the Operator will be interviewed to obtain and review available data sources in support of the assessment, e.g., operations and maintenance information; TCW fluid SDS sheets; and SDS sheets for chemical additives known to be acutely toxic, e.g., biocides.

4.6 Quality Assurance Project Plan (QAPP)

The purpose of the JIP study Quality Assurance/Quality Control (QA/QC) program is to establish the analytical protocols and documentation necessary to ensure that data are generated, reviewed, and assessed in a consistent manner. This will ensure that the data are scientifically sound, of known and documented quality, and suitable to meet JIP study Data Quality Objectives (DQOs). The QAPP describes the quality requirements for sampling and analysis of TCW discharge samples collected and analyzed under the SAP to ensure that quality data are obtained. An overview is provided in this sub-section; the proposed draft QAPP is provided in **Appendix B**.

The overall QA/QC goal for the JIP study is to collect data suitable to meet the DQOs, which involve quantitative and qualitative evaluations as input for technical decisions. In regard to measurement data quality, the QA/QC program will:

- Provide a mechanism for the ongoing control and evaluation of measurement data quality; and
- Provide metrics of data quality in terms of accuracy, precision, completeness, representativeness, and comparability, with which to assess whether the data meet the quality objectives and can be used for their intended purpose.

The draft QAPP was prepared consistent with the USEPA (2012) *Intergovernmental Data Quality Task Force; Uniform Federal Policy (UFP) for Quality Assurance Project Plans Optimized UFP-QAPP Worksheets* guidance and USEPA 2106-G-05. As discussed by USEPA (2012), use of the UFP-QAPP is applicable to any environmental program for which data will be collected and analyzed, and worksheets can be customized accordingly. A summary of the QAPP worksheets selected and the rationale for their selection is provided in **Table 4-3**.

5.0 Reporting

This section describes reporting requirements for (1) status reports; and (2) a final study report.

5.1 Status Reports

Summary status reports will be prepared and submitted to USEPA during the study period. The reports will be submitted to USEPA on a quarterly basis and will (1) describe the activities conducted during the previous three months; (2) discuss any special problems or observations that may have an effect on future sampling operations; and (3) provide a numerical summary of samples collected and resources expended on sampling activities. The summary reports will be distributed electronically and provided to USEPA by close of business on the last Friday of the quarter.

5.2 Final Study Report

A final study report will be prepared and submitted to USEPA on October 1, 2021. The purpose of the report is to address the study questions regarding TCW discharge quality and the potential for TCW discharges to cause acute aquatic toxicity towards aquatic biota. The report will discuss the potential for toxicity associated with constituents identified in the sampled TCW discharges. General report elements will include (where applicable):

- Summary of likely constituents in TCW fluids, including aquatic hazard characteristics;
- Summary of WET testing and laboratory analytical data;
- Data evaluations; and
- Laboratory reports.

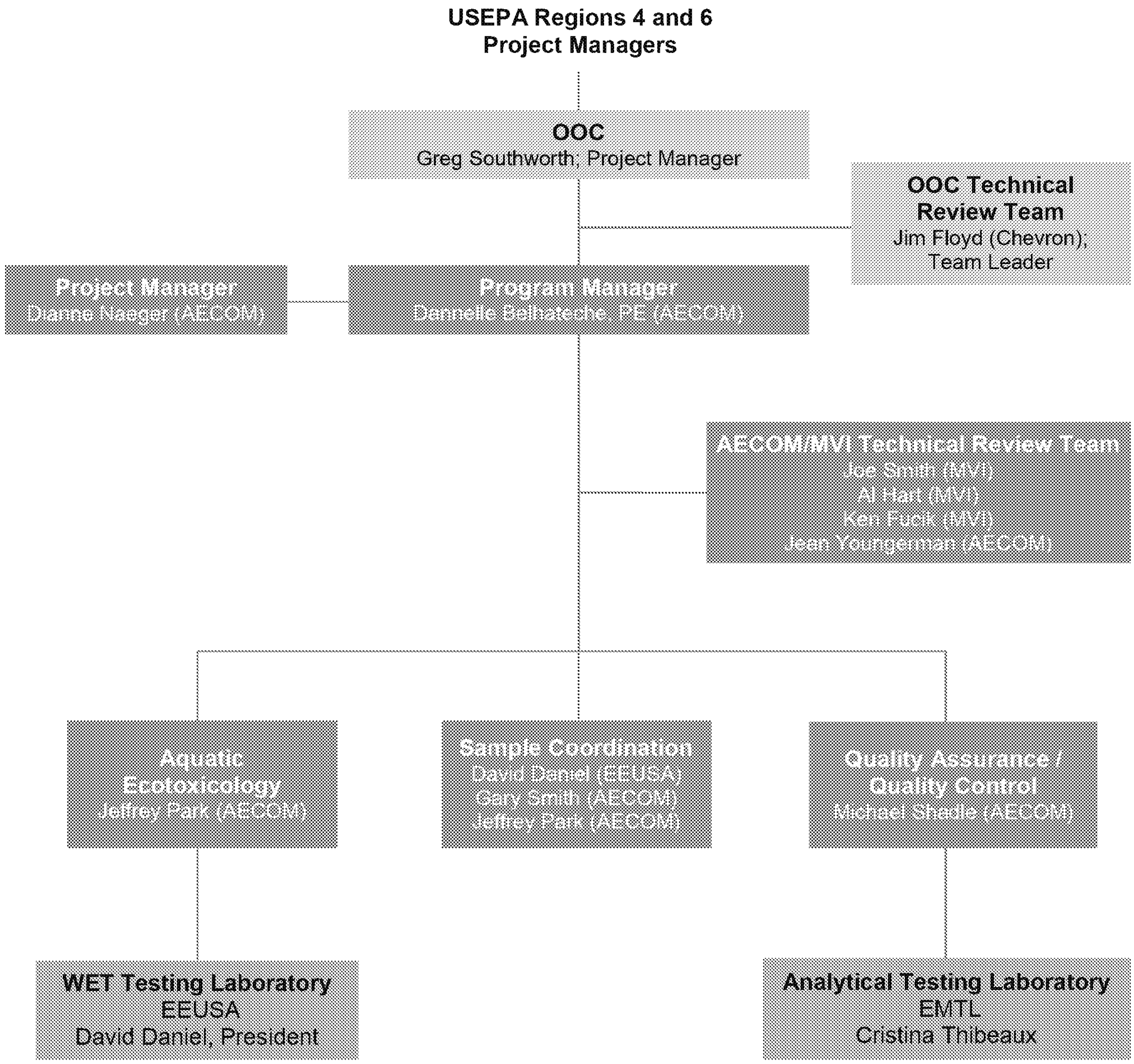
6.0 Study Schedule

The anticipated schedule for the JIP study plan elements is provided below:

Study Plan Element	Anticipated Completion Date
Draft Study Plan Submittal to USEPA	March 2019
Meeting with USEPA to Discuss Draft Study Plan	April 2019
Step 1: Preliminary Characterization	Q2 2019
Step 2: Sample Collection and Analysis	Q2 2019 – Q4 2020
Step 3: Data Evaluation	Q3 2021
Interpretive Report to USEPA	October 1, 2021
Status Reports to USEPA	Throughout on a quarterly basis

7.0 Project Organization

This section identifies the JIP study organizational structure. Team members and associated roles/responsibilities are presented below:



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Tables

Table 2-1
GP Requirements
Joint Industry Project Study Plan for TCW Discharges
Gulf of Mexico: Western and Central Planning Regions

Data Requirement (Characteristic Assessment)		USEPA Region 4	USEPA Region 6
General	Lease & block number	Yes	Yes
	API well number	Yes	Yes
	Type of well treatment or workover operation	Yes	Yes
	Date of discharge	Yes	Yes
	Time discharge commenced	Yes	Yes
	Duration of discharge	Yes	Yes
TCW Fluids	Volume of well treatment	Yes	Yes
	Volume of completion or workover fluids used	Yes	Yes
	The common names and chemical parameters for all additives to the fluids	Yes	Yes
	The volume of each additive	Yes	Yes
	Concentration of all additives in the well treatment	Yes	Yes
	Concentration of all additives in the completion or workover fluid	Yes	Yes
TCW Discharge	Additional requirements for characterizing the chemical composition and toxicity of the discharges	Yes	Yes
	Whole effluent toxicity (WET) test, or other appropriate toxicity test	Yes	Yes
	Acute WET Test (USEPA-821-R-02-012)	For discharges <4 consecutive days	Yes
	Acute WET test endpoint	48-hour LC50	48-hour NOEC
	Acute mixing zone allowance	ACD at edge of 100m mixing zone. ACD = 1* LC50	At edge of 100 meter(m) mixing zone
	Chronic WET test (USEPA-821-R-02-014)	For discharges >4 consecutive days	No
	Chronic WET test endpoint	7-day NOEC	Not applicable
	Chronic mixing zone allowance	At edge of 100m mixing zone	Not applicable
	Sample collection point	After final treatment and before discharge to surface water	Not specified
	Statistically valid sample size	Yes	Yes

Notes:
ACD; Acute Critical Dilution
API; American Petroleum Institute
GP; General Permit
LC50; 50 Percent Median Lethal Concentration
m; Meter
NOEC; No Observed Effect Concentration
USEPA; U.S. Environmental Protection Agency
WET; Whole Effluent Toxicity

Table 3-1
Details of Planned TCW Discharges
Joint Industry Project Study Plan for TCW Discharges
Gulf of Mexico: Western and Central Planning Regions

Historical, Existing or Planned?	Planned	Planned	Planned	Planned	Planned	Planned	Planned	Planned	Planned
Date or Anticipated Start Date	Aug-19	Dec-19	Apr-20	3/3/2019	5/7/2019	5/21/2019	4/2/2019	Q1-2019	Q1-2019
SECTION 1. General Information									
1. Area:	Green Canyon	Green Canyon	Green Canyon	Viosca Knoll	High Island	Ship Shoal 28	Ship Shoal 349	Ewing Bank	Ewing Bank
2. Water Column Depth (ft.)	3,328	3,325	3,330	1,132	390	TBD	375	1,700	1,700
SECTION 2. Treatment Completion and Workover (TCW) Fluids									
1. What type of well treatment or workover operation is conducted? Please provide a brief description:	P&A/Complete	P&A/Complete	P&A/Complete	Initial Completion	Initial Completion	Initial Completion	Initial Completion	P&A	P&A
2. What types of TCW fluids are used?	--	--	--	--	--	--	--	--	--
a. Category I	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. Category II	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
c. Category III	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
d. Category IV	Yes	Yes	Yes	No	No	No	No	No	No
e. Other:	--	--	--	--	--	--	--	--	--
3. Are there jobs where one, or a combination of TCW fluid categories are discharged to surface waters? If yes, proceed to Section 3.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SECTION 3. Discharge of TCW Wastewaters to Surface Water									
1. Are TCW wastewaters commingled and discharged as part of produced water?	No	No	No	No	No	No	No	No	No
2. Are TCW wastewaters discharged directly to surface water without treatment or storage in a tank?	No	No	No	No	No	No	No	No	No
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	--	--	--	Yes	Yes	Yes	Yes	--	--
b. What is the pipe diameter (inches)?	--	--	--	Varies	Varies	Varies	Varies	--	--
3. Are TCW wastewaters discharged to a tank on the Facility and then discharged overboard?	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	--	--	--	Yes	Yes	Yes	Yes	Yes	Yes
b. What is the pipe diameter (inches)?	--	--	--	Varies	Varies	Varies	Varies	Unknown	Unknown
4. Are TCW wastewaters discharged via a hose off the tank?	No	No	No	Yes	Yes	Yes	Yes	No	No
a. If yes, what is the hose diameter (inches)?	--	--	--	Varies	Varies	Varies	Varies	--	--
5. Are the TCW wastewaters discharged above the ocean surface?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
a. If yes, at what height above the water column does the discharge occur?	20 ft	20 ft	20 ft	Varies	Varies	Varies	Varies	--	--
b. If no, at what water column depth does the discharge occur?	–	–	–	--	--	--	--	Unknown	Unknown
6. Typically, how often are TCW wastewaters discharged, e.g., once a week, quarterly?	One time per well	One time per well	One time per well	Fluids are not discharged on a daily or weekly basis but rather once needed as per operation	Fluids are not discharged on a daily or weekly basis but rather once needed as per operation	Fluids are not discharged on a daily or weekly basis but rather once needed as per operation	Fluids are not discharged on a daily or weekly basis but rather once needed as per operation	weekly	weekly
7. Typically, what is the duration of the discharge (minutes/hours)?	2 hours	2 hours	2 hours	Varies	Varies	Varies	Varies	minutes	minutes
8. Are TCW wastewaters discharged back to the Facility and passed through a filtration system before discharging overboard?	No	No	No	Yes	Yes	Yes	Yes	No	No
a. Do you use a designated discharge point such as a pipe, if so, what is the diameter (in.)?	–	–	–	Varies	Varies	Varies	Varies	–	–
b. Do you use a hose off of the Filtration system, if so what is the diameter (in.)?	–	–	–	Varies	Varies	Varies	Varies	–	–
c. Are wastewaters discharged via any other structure, e.g., diffuser? If yes, please describe:	–	–	–	--	--	--	--	–	–
9. Is any other treatment of TCW wastewaters conducted? If yes, please describe:	N/A	N/A	N/A	Static sheen tests are always performed prior to discharging fluids, if fluid does not pass this test it is disposed of rather than discharged	Static sheen tests are always performed prior to discharging fluids, if fluid does not pass this test it is disposed of rather than discharged	Static sheen tests are always performed prior to discharging fluids, if fluid does not pass this test it is disposed of rather than discharged	Static sheen tests are always performed prior to discharging fluids, if fluid does not pass this test it is disposed of rather than discharged	–	–
SECTION 4. Discharge of Other Wastewaters (Zinc Bromide; Acid Jobs; Chemical Additives) to Surface Water									
1. Are zinc bromide wastewaters sent onshore for disposal?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	–
a. If no, how are zinc bromide wastewaters disposed?	–	–	–	Bromide fluids are typically sold back to the fluid provider after being used. If for any reason the fluid is not up to spec for buyback (density too low, iron content too high, etc) it is disposed of onshore at an appropriate facility	Bromide fluids are typically sold back to the fluid provider after being used. If for any reason the fluid is not up to spec for buyback (density too low, iron content too high, etc) it is disposed of onshore at an appropriate facility	Bromide fluids are typically sold back to the fluid provider after being used. If for any reason the fluid is not up to spec for buyback (density too low, iron content too high, etc) it is disposed of onshore at an appropriate facility	Bromide fluids are typically sold back to the fluid provider after being used. If for any reason the fluid is not up to spec for buyback (density too low, iron content too high, etc) it is disposed of onshore at an appropriate facility	–	–
b. Other:				--	--	--	--	--	--
2. **Applicable to TCW jobs only**: Are acid jobs conducted? If yes, how are acidic wastewaters treated?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
a. Do you send onshore for disposal?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	–	–
b. Do you discharge acid job wastewaters directly overboard without treatment?	No	No	No	No	No	No	No	–	–
c. Do you neutralize the pH and then discharge overboard?	No	No	No	No	No	No	No	–	–
d. Other	–	–	–	Spent acid is taken back by the 3rd party who provides it and discharged at their facility	Spent acid is taken back by the 3rd party who provides it and discharged at their facility	Spent acid is taken back by the 3rd party who provides it and discharged at their facility	Spent acid is taken back by the 3rd party who provides it and discharged at their facility	–	–
3. **Applicable to TCW jobs only**: Is there the potential for corrosion inhibitors, deemulsifiers, surfactants, defoamers, or biocides to be comingled with TCW wastewaters? If yes, please identify the type:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	–	–
a. Corrosion inhibitor:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
b. Deemulsifier:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
c. Surfactants	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
d. Defoamers:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
e. Biocides:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
f. Other:	–	–	–	--	--	--	--	–	–

Table 3-1
Details of Planned TCW Discharges
Joint Industry Project Study Plan for TCW Discharges
Gulf of Mexico: Western and Central Planning Regions

Historical, Existing or Planned?	Planned	Planned	Planned	Planned	Planned	Planned	Planned	Planned	Pending	Pending
Date or Anticipated Start Date	Q1-2019	Q1-2019	Q1-2019	Q2-2019	Q2 2019	Q2 2019	Q2 2019	Q3 2019	Q3 2019	Q3 2019
SECTION 1. General Information										
1. Area:	Ewing Bank	Ewing Bank	Ewing Bank	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Walker Ridge	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon
2. Water Column Depth (ft.)	1,700	1,700	1,700	5,600	7,391	4,524	9,558	7,157	7,210	7,210
SECTION 2. Treatment Completion and Workover (TCW) Fluids										
1. What type of well treatment or workover operation is conducted? Please provide a brief description:	P&A	P&A	P&A	Initial Completion	Completion	Workover	Workover (Temporary Abandonment)	Completion	Completion	Completion
2. What types of TCW fluids are used?	--	--	--	--	--	TBD	TBD	--	--	--
a. Category I	Yes	Yes	Yes	Yes	Yes			Yes	Yes	Yes
b. Category II	No	No	No	No	No			No	No	No
c. Category III	No	No	No	No	No			No	No	No
d. Category IV	No	No	No	No	No			No	No	No
e. Other:	--	--	--	--	SBM			SBM	SBM	
3. Are there jobs where one, or a combination of TCW fluid categories are discharged to surface waters? If yes, proceed to Section 3.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SECTION 3. Discharge of TCW Wastewaters to Surface Water										
1. Are TCW wastewaters commingled and discharged as part of produced water?	No	No	No	No	No	No	No	No	No	No
2. Are TCW wastewaters discharged directly to surface water without treatment or storage in a tank?	No	No	No	No	No	No	No	No	No	No
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	--	--	--	--	Yes	Yes	Yes	Yes	Yes	Yes
b. What is the pipe diameter (inches)?	--	--	--	--	16in	16in	16in	16in	16in	16in
3. Are TCW wastewaters discharged to a tank on the Facility and then discharged overboard?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. What is the pipe diameter (inches)?	Unknown	Unknown	Unknown	Unknown	16in	16in	16in	16in	16in	16in
4. Are TCW wastewaters discharged via a hose off the tank?	No	No	No	No	No	No	No	No	No	No
a. If yes, what is the hose diameter (inches)?	--	--	--	--	n/a	n/a	n/a	n/a	n/a	n/a
5. Are the TCW wastewaters discharged above the ocean surface?	No	No	No	No	No	No	No	No	No	No
a. If yes, at what height above the water column does the discharge occur?	--	--	--	--	n/a	n/a	n/a	n/a	n/a	n/a
b. If no, at what water column depth does the discharge occur?	Unknown	Unknown	Unknown	Unknown	36ft	36ft	36ft	36ft	36ft	36ft
6. Typically, how often are TCW wastewaters discharged, e.g., once a week, quarterly?	weekly	weekly	weekly	weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly
7. Typically, what is the duration of the discharge (minutes/hours)?	minutes	minutes	minutes	minutes	30 minutes	30 minutes	30 minutes	30 minutes	30 minutes	30 minutes
8. Are TCW wastewaters discharged back to the Facility and passed through a filtration system before discharging overboard?	No	No	No	No	Yes	No	No	Yes	Yes	Yes
a. Do you use a designated discharge point such as a pipe, if so, what is the diameter (in.)?	–	–	–	–	23-in., equiv. area (non-circular, multi-slot discharge)	n/a	n/a	23-in., equiv. area (non-circular, multi-slot discharge)	23-in., equiv. area (non-circular, multi-slot discharge)	23-in., equiv. area (non-circular, multi-slot discharge)
b. Do you use a hose off of the Filtration system, if so what is the diameter (in.)?	–	–	–	–	n/a	n/a	n/a	n/a	n/a	n/a
c. Are wastewaters discharged via any other structure, e.g., diffuser? If yes, please describe:	–	–	–	–	No	No	No	No	No	No
9. Is any other treatment of TCW wastewaters conducted? If yes, please describe:	–	–	–	–	No	No	No	No	No	No
SECTION 4. Discharge of Other Wastewaters (Zinc Bromide; Acid Jobs; Chemical Additives) to Surface Water										
1. Are zinc bromide wastewaters sent onshore for disposal?	–	–	–	–	No			No	No	No
a. If no, how are zinc bromide wastewaters disposed?	–	–	–	–	N/A			N/A	N/A	N/A
b. Other:	--	--	--	--	N/A			N/A	N/A	N/A
2. **Applicable to TCW jobs only**: Are acid jobs conducted? If yes, how are acidic wastewaters treated?	No	No	No	Yes	No			No	No	No
a. Do you send onshore for disposal?	–	–	–	Yes	Yes			Yes	Yes	Yes
b. Do you discharge acid job wastewaters directly overboard without treatment?	–	–	–	No	No			No	No	No
c. Do you neutralize the pH and then discharge overboard?	–	–	–	No	No			No	No	No
d. Other	–	–	–	–	N/A			N/A	N/A	N/A
3. **Applicable to TCW jobs only**: Is there the potential for corrosion inhibitors, deemulsifiers, surfactants, defoamers, or biocides to be comingled with TCW wastewaters? If yes, please identify the type:	–	–	–	–	Yes			Yes	Yes	Yes
a. Corrosion inhibitor:	No	No	No	No	No			No	No	No
b. Deemulsifier:	No	No	No	No	Yes			Yes	Yes	Yes
c. Surfactants	No	No	No	No	Yes			Yes	Yes	Yes
d. Defoamers:	No	No	No	No	Yes			Yes	Yes	Yes
e. Biocides:	No	No	No	No	Yes			Yes	Yes	Yes
f. Other:	–	–	–	–	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning

Table 3-1
Details of Planned TCW Discharges
Joint Industry Project Study Plan for TCW Discharges
Gulf of Mexico: Western and Central Planning Regions

Historical, Existing or Planned?	Pending	Pending	Planned	Pending	Pending	Pending	Pending	Planned	Planned	Planned
Date or Anticipated Start Date	Q4 2019	Q4 2019	Q4 2019	Q2 2020	Q2 2020	Q4 2020	Q4 2020	Q2 2019	Q2 2019	Q2 2019
SECTION 1. General Information										
1. Area:	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon
2. Water Column Depth (ft.)	7,157	7,210	7,210	7,391	7,157	7,391	7,157	7,344	7,344	7,344
SECTION 2. Treatment Completion and Workover (TCW) Fluids										
1. What type of well treatment or workover operation is conducted? Please provide a brief description:	Completion	Completion	Injector	Completion	Injector	Completion	Completion	Completion - Initial Well Flowback	Completion - Initial Well Flowback	Completion - Initial Well Flowback
2. What types of TCW fluids are used?	--	--	--	--	--	--	--	--	--	--
a. Category I	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. Category II	No	No	No	No	No	No	No	No	No	No
c. Category III	No	No	Yes	No	Yes	No	No	No	No	No
d. Category IV	No	No	No	No	No	No	No	No	No	No
e. Other:										
3. Are there jobs where one, or a combination of TCW fluid categories are discharged to surface waters? If yes, proceed to Section 3.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SECTION 3. Discharge of TCW Wastewaters to Surface Water										
1. Are TCW wastewaters commingled and discharged as part of produced water?	No	No	No	No	No	No	No	No	No	No
2. Are TCW wastewaters discharged directly to surface water without treatment or storage in a tank?	No	No	No	No	No	No	No	No	No	No
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. What is the pipe diameter (inches)?	16in	16in	16in	16in	16in	16in	16in	16in	16in	16in
3. Are TCW wastewaters discharged to a tank on the Facility and then discharged overboard?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. What is the pipe diameter (inches)?	16in	16in	16in	16in	16in	16in	16in	16in	16in	16in
4. Are TCW wastewaters discharged via a hose off the tank?	No	No	No	No	No	No	No	No	No	No
a. If yes, what is the hose diameter (inches)?	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5. Are the TCW wastewaters discharged above the ocean surface?	No	No	No	No	No	No	No	No	No	No
a. If yes, at what height above the water column does the discharge occur?	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
b. If no, at what water column depth does the discharge occur?	36ft	36ft	36ft	36ft	36ft	36ft	36ft	99 ft	99 ft	99 ft
6. Typically, how often are TCW wastewaters discharged, e.g., once a week, quarterly?	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly
7. Typically, what is the duration of the discharge (minutes/hours)?	30 minutes	30 minutes	30 minutes	30 minutes	30 minutes	30 minutes	30 minutes	hours	hours	hours
8. Are TCW wastewaters discharged back to the Facility and passed through a filtration system before discharging overboard?	Yes	Yes	No	Yes	No	Yes	Yes	No	No	No
a. Do you use a designated discharge point such as a pipe, if so, what is the diameter (in.)?	23-in., equiv. area (non-circular, multi-slot discharge)	23-in., equiv. area (non-circular, multi-slot discharge)	n/a	23-in., equiv. area (non-circular, multi-slot discharge)	n/a	23-in., equiv. area (non-circular, multi-slot discharge)	23-in., equiv. area (non-circular, multi-slot discharge)	23-in., equiv. area (non-circular, multi-slot discharge)	23-in., equiv. area (non-circular, multi-slot discharge)	23-in., equiv. area (non-circular, multi-slot discharge)
b. Do you use a hose off of the Filtration system, if so what is the diameter (in.)?	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
c. Are wastewaters discharged via any other structure, e.g., diffuser? If yes, please describe:	No	No	No	No	No	No	No	No	No	No
9. Is any other treatment of TCW wastewaters conducted? If yes, please describe:	No	No	No	No	No	No	No	Yes. Filtration, but still planning	Yes. Filtration, but still planning	Yes. Filtration, but still planning
SECTION 4. Discharge of Other Wastewaters (Zinc Bromide; Acid Jobs; Chemical Additives) to Surface Water										
1. Are zinc bromide wastewaters sent onshore for disposal?	No	No	No	No	No	No	No	No	No	No
a. If no, how are zinc bromide wastewaters disposed?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
b. Other:	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2. **Applicable to TCW jobs only**: Are acid jobs conducted? If yes, how are acidic wastewaters treated?	No	No	No	No	No	No	No	No	No	No
a. Do you send onshore for disposal?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. Do you discharge acid job wastewaters directly overboard without treatment?	No	No	No	No	No	No	No	No	No	No
c. Do you neutralize the pH and then discharge overboard?	No	No	No	No	No	No	No	No	No	No
d. Other	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3. **Applicable to TCW jobs only**: Is there the potential for corrosion inhibitors, deemulsifiers, surfactants, defoamers, or biocides to be comingled with TCW wastewaters? If yes, please identify the type:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a. Corrosion inhibitor:	No	No	No	No	No	No	No	No	No	No
b. Deemulsifier:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
c. Surfactants	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
d. Defoamers:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
e. Biocides:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
f. Other:	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown - still planning initial well flowback to host facility	unknown - still planning initial well flowback to host facility	unknown - still planning initial well flowback to host facility

Table 3-1
Details of Planned TCW Discharges
Joint Industry Project Study Plan for TCW Discharges
Gulf of Mexico: Western and Central Planning Regions

Historical, Existing or Planned?	Planned	Planned	Planned	Planned	Planned	Planned	Planned	Planned	Planned	Tentative
Date or Anticipated Start Date	Q2 2019	Q3 2020	Q3 2020	Q2 2019	Q3 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020
SECTION 1. General Information										
1. Area:	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Garden Banks	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Walker Ridge	Alaminos Canyon
2. Water Column Depth (ft.)	7,344	7,344	7,344	2,650	4,524	4,524	4,524	4,524	9,558	9,000
SECTION 2. Treatment Completion and Workover (TCW) Fluids										
1. What type of well treatment or workover operation is conducted? Please provide a brief description:	Completion - Initial Well Flowback	Completion - Initial Well Flowback	Completion - Initial Well Flowback	Completion	Completion	Abandonment	Completion	Completion	Completion	Completion (Producer) OHGP
2. What types of TCW fluids are used?	--	--	--	--	--	--	--	--	--	--
a. Category I	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. Category II	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
c. Category III	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
d. Category IV	No	No	No	No	No	No	No	No	No	No
e. Other:										
3. Are there jobs where one, or a combination of TCW fluid categories are discharged to surface waters? If yes, proceed to Section 3.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SECTION 3. Discharge of TCW Wastewaters to Surface Water										
1. Are TCW wastewaters commingled and discharged as part of produced water?	No	No	No	No	No	No	No	No	No	No
2. Are TCW wastewaters discharged directly to surface water without treatment or storage in a tank?	No	No	No	No	No	No	No	No	No	No
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	Yes	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A
b. What is the pipe diameter (inches)?	16in	16in	16in	-	-	-	-	-	-	-
3. Are TCW wastewaters discharged to a tank on the Facility and then discharged overboard?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	Yes	Yes	Yes	yes	yes	yes	yes	yes	yes	yes
b. What is the pipe diameter (inches)?	16in	16in	16in	16"	16"	16"	16"	16"	16"	16"
4. Are TCW wastewaters discharged via a hose off the tank?	No	No	No	No	No	No	No	No	No	No
a. If yes, what is the hose diameter (inches)?	n/a	n/a	n/a	-	-	-	-	-	-	-
5. Are the TCW wastewaters discharged above the ocean surface?	No	No	No	-	-	-	-	-	-	-
a. If yes, at what height above the water column does the discharge occur?	n/a	n/a	n/a	-	-	-	-	-	-	-
b. If no, at what water column depth does the discharge occur?	99 ft	99 ft	99 ft	over 40ft	over 40ft	over 40ft	over 40ft	over 40ft	over 40ft	over 40ft
6. Typically, how often are TCW wastewaters discharged, e.g., once a week, quarterly?	Weekly	Weekly	Weekly	quarterly	quarterly	quarterly	quarterly	quarterly	unknown	quarterly
7. Typically, what is the duration of the discharge (minutes/hours)?	hours	hours	hours	30 mins	30 mins	30 mins	30 mins	30 mins	30 mins	30 mins
8. Are TCW wastewaters discharged back to the Facility and passed through a filtration system before discharging overboard?	No	No	No	No	No	No	No	No	No	No
a. Do you use a designated discharge point such as a pipe, if so, what is the diameter (in.)?	23-in., equiv. area (non-circular, multi-slot discharge)	23-in., equiv. area (non-circular, multi-slot discharge)	23-in., equiv. area (non-circular, multi-slot discharge)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
b. Do you use a hose off of the Filtration system, if so what is the diameter (in.)?	n/a	n/a	n/a	N/A	N/A	N/A	N/A	N/A	N/A	N/A
c. Are wastewaters discharged via any other structure, e.g., diffuser? If yes, please describe:	No	No	No	No	No	No	No	No	No	No
9. Is any other treatment of TCW wastewaters conducted? If yes, please describe:	Yes. Filtration, but still planning	Yes. Filtration, but still planning	Yes. Filtration, but still planning	No	No	No	No	No	No	No
SECTION 4. Discharge of Other Wastewaters (Zinc Bromide; Acid Jobs; Chemical Additives) to Surface Water										
1. Are zinc bromide wastewaters sent onshore for disposal?	No	No	No	No	Yes	No	Yes	Yes	Yes	No
a. If no, how are zinc bromide wastewaters disposed?	N/A	N/A	N/A	N/A	Sent in for Disposal	N/A	Sent in for Disposal	Sent in for Disposal	Sent in for Disposal	N/A
b. Other:	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2. **Applicable to TCW jobs only**: Are acid jobs conducted? If yes, how are acidic wastewaters treated?	No	No	No						Yes	No
a. Do you send onshore for disposal?	Yes	Yes	Yes						Yes	
b. Do you discharge acid job wastewaters directly overboard without treatment?	No	No	No						No	
c. Do you neutralize the pH and then discharge overboard?	No	No	No						Yes	
d. Other	N/A	N/A	N/A							
3. **Applicable to TCW jobs only**: Is there the potential for corrosion inhibitors, deemulsifiers, surfactants, defoamers, or biocides to be comingled with TCW wastewaters? If yes, please identify the type:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a. Corrosion inhibitor:	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. Deemulsifier:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
c. Surfactants	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
d. Defoamers:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
e. Biocides:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
f. Other:	unknown - still planning initial well flowback to host facility	unknown - still planning initial well flowback to host facility	unknown - still planning initial well flowback to host facility	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning

Table 3-1
Details of Planned TCW Discharges
Joint Industry Project Study Plan for TCW Discharges
Gulf of Mexico: Western and Central Planning Regions

Historical, Existing or Planned?	Tentative	Tentative	Planned	Planned	Planned	Planned	Planned	Planned	Pending	Pending
Date or Anticipated Start Date	Q3 2020	Q4 2020	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q2 2020	Q3 2020	Q4 2020
SECTION 1. General Information										
1. Area:	Alaminos Canyon	Alaminos Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon
2. Water Column Depth (ft.)	9,000	9,000	3,980	3,980	TBD	TBD	TBD	TBD	TBD	7,645
SECTION 2. Treatment Completion and Workover (TCW) Fluids										
1. What type of well treatment or workover operation is conducted? Please provide a brief description:	Completion (Producer) OHGP	Completion (Producer) OHGP	Completion CHFP	Completion CHFP	Completion	Completion	Completion	Completion	Completion	Completion
2. What types of TCW fluids are used?	--	--	--	--	--	--	--	--	--	--
a. Category I	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
b. Category II	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
c. Category III	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
d. Category IV	No	No	No	No	No	No	No	No		
e. Other:										
3. Are there jobs where one, or a combination of TCW fluid categories are discharged to surface waters? If yes, proceed to Section 3.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SECTION 3. Discharge of TCW Wastewaters to Surface Water										
1. Are TCW wastewaters commingled and discharged as part of produced water?	No	No	No	No	No	No	No	No	No	No
2. Are TCW wastewaters discharged directly to surface water without treatment or storage in a tank?	No	No	No	No						
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	N/A	N/A	-	-	-	-	-	-	-	-
b. What is the pipe diameter (inches)?	-	-	-	-	-	-	-	-	-	-
3. Are TCW wastewaters discharged to a tank on the Facility and then discharged overboard?	Yes	Yes								
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	yes	yes	YES	YES	YES	YES	YES	YES	YES	YES
b. What is the pipe diameter (inches)?	16"	16"	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
4. Are TCW wastewaters discharged via a hose off the tank?	No	No	No	No	No	No	No	No	No	No
a. If yes, what is the hose diameter (inches)?	-	-	-	-	-	-	-	-	-	-
5. Are the TCW wastewaters discharged above the ocean surface?	-	-	No	No	No	No	No	No	No	No
a. If yes, at what height above the water column does the discharge occur?	-	-	-	-	-	-	-	-	-	-
b. If no, at what water column depth does the discharge occur?	over 40ft	over 40ft	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
6. Typically, how often are TCW wastewaters discharged, e.g., once a week, quarterly?	quarterly	quarterly	weekly	weekly	weekly	weekly	weekly	weekly	weekly	weekly
7. Typically, what is the duration of the discharge (minutes/hours)?	30 mins	30 mins	30 min	30 min	30 min	30 min	30 min	30 min	30 min	30 min
8. Are TCW wastewaters discharged back to the Facility and passed through a filtration system before discharging overboard?	No	No	No	No	No	No	No	No	No	No
a. Do you use a designated discharge point such as a pipe, if so, what is the diameter (in.)?	N/A	N/A	-	-	-	-	-	-	-	-
b. Do you use a hose off of the Filtration system, if so what is the diameter (in.)?	N/A	N/A	-	-	-	-	-	-	-	-
c. Are wastewaters discharged via any other structure, e.g., diffuser? If yes, please describe:	No	No	-	-	-	-	-	-	-	-
9. Is any other treatment of TCW wastewaters conducted? If yes, please describe:	No	No								
SECTION 4. Discharge of Other Wastewaters (Zinc Bromide; Acid Jobs; Chemical Additives) to Surface Water										
1. Are zinc bromide wastewaters sent onshore for disposal?	No	No	No	No						
a. If no, how are zinc bromide wastewaters disposed?	N/A	N/A								
b. Other:	N/A	N/A								
2. **Applicable to TCW jobs only**: Are acid jobs conducted? If yes, how are acidic wastewaters treated?	No	No	Yes	Yes						
a. Do you send onshore for disposal?			Yes	Yes						
b. Do you discharge acid job wastewaters directly overboard without treatment?			No	No						
c. Do you neutralize the pH and then discharge overboard?			No	No						
d. Other										
3. **Applicable to TCW jobs only**: Is there the potential for corrosion inhibitors, deemulsifiers, surfactants, defoamers, or biocides to be comingled with TCW wastewaters? If yes, please identify the type:	Yes	Yes	Yes	Yes						
a. Corrosion inhibitor:	Yes	Yes	Yes	Yes						
b. Deemulsifier:	Yes	Yes	Yes	Yes						
c. Surfactants	Yes	Yes	Yes	Yes						
d. Defoamers:	Yes	Yes	No	No						
e. Biocides:	Yes	Yes	Yes	Yes						
f. Other:	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning	unknown- still planning

Table 3-1
Details of Planned TCW Discharges
Joint Industry Project Study Plan for TCW Discharges
Gulf of Mexico: Western and Central Planning Regions

Historical, Existing or Planned?	Planned	Planning	Planning	Planning	Planning	Planning	Planning	Planning	Planning	Planned
Date or Anticipated Start Date	Q4 2020	Q4 2020	Q2 2019	Q3 2019	Q1 2020	Q3 2020	Q1 2020	Q1 2020	Q3 2020	Q3 2019
SECTION 1. General Information										
1. Area:	Garden Banks	Garden Banks	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Alaminos Canyon	Alaminos Canyon	Alaminos Canyon	Mississippi Canyon
2. Water Column Depth (ft.)	2,840	2,840	2,490	2,490	2,490	2,490	7,815	7,815	7,815	3,030
SECTION 2. Treatment Completion and Workover (TCW) Fluids										
1. What type of well treatment or workover operation is conducted? Please provide a brief description:	Recomplete	Completion	Completion	Completion	Completion	Completion	Completion	Completion	Completion	Completion
2. What types of TCW fluids are used?	--	--	--	--			--	--		--
a. Category I	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. Category II	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
c. Category III	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
d. Category IV	No						No	No	No	No
e. Other:										
3. Are there jobs where one, or a combination of TCW fluid categories are discharged to surface waters? If yes, proceed to Section 3.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SECTION 3. Discharge of TCW Wastewaters to Surface Water										
1. Are TCW wastewaters commingled and discharged as part of produced water?	No		No	No	No	No	No	No	No	No
2. Are TCW wastewaters discharged directly to surface water without treatment or storage in a tank?	No		No	No	No	No	No	No	No	No
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	See Comment		Yes	Yes	Yes	Yes	N/A	N/A	N/A	N/A
b. What is the pipe diameter (inches)?	See Comment		14	14	14	14	N/A	N/A	N/A	N/A
3. Are TCW wastewaters discharged to a tank on the Facility and then discharged overboard?	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	Yes		Yes	Yes	Yes	Yes	yes	yes	yes	Yes
b. What is the pipe diameter (inches)?	16"		14	14	14	14	16"	16"	16"	16"
4. Are TCW wastewaters discharged via a hose off the tank?	No		No	No	No	No	No	No	No	No
a. If yes, what is the hose diameter (inches)?	NA		N/a	N/a	N/a	N/a	N/A	N/A	N/A	N/A
5. Are the TCW wastewaters discharged above the ocean surface?	No		No	No	No	No	No	No	No	No
a. If yes, at what height above the water column does the discharge occur?	NA		N/a	N/a	N/a	N/a	N/A	N/A	N/A	
b. If no, at what water column depth does the discharge occur?	72 feet		12'	12'	12'	12'	±40-60ft	±40-60ft	±40-60ft	78'
6. Typically, how often are TCW wastewaters discharged, e.g., once a week, quarterly?	Weekly		Monthly	Monthly	Monthly	Monthly	weekly	weekly	weekly	After passing a sheen test
7. Typically, what is the duration of the discharge (minutes/hours)?	<30 minutes		30 min	30 min	30 min	30 min	30mins	30mins	30mins	30
8. Are TCW wastewaters discharged back to the Facility and passed through a filtration system before discharging overboard?	No		No	No	No	No	No	No	No	No
a. Do you use a designated discharge point such as a pipe, if so, what is the diameter (in.)?	Yes.		14	14	14	14	N/A	N/A	N/A	16"
b. Do you use a hose off of the Filtration system, if so what is the diameter (in.)?	16"		no	no	no	no	N/A	N/A	N/A	Yes
c. Are wastewaters discharged via any other structure, e.g., diffuser? If yes, please describe:	No		no	no	no	no	N/A	N/A	N/A	No
9. Is any other treatment of TCW wastewaters conducted? If yes, please describe:	No		no	no	no	no	No treatment is conducted, but we do static sheen testing and monthly oil & grease samples.	No treatment is conducted, but we do static sheen testing and monthly oil & grease samples.		Sheen Test
SECTION 4. Discharge of Other Wastewaters (Zinc Bromide; Acid Jobs; Chemical Additives) to Surface Water										
1. Are zinc bromide wastewaters sent onshore for disposal?	Yes		Yes	Yes	Yes	Yes	No	No	No	Yes
a. If no, how are zinc bromide wastewaters disposed?			N/a	N/a	N/a	N/a	N/A	N/A	N/A	
b. Other:			N/a	N/a	N/a	N/a	N/A	N/A	N/A	
2. **Applicable to TCW jobs only**: Are acid jobs conducted? If yes, how are acidic wastewaters treated?	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a. Do you send onshore for disposal?	Yes		Yes	Yes	Yes	Yes	No	No	No	Yes
b. Do you discharge acid job wastewaters directly overboard without treatment?	No		No	No	No	No	No	No	No	No
c. Do you neutralize the pH and then discharge overboard?	No		No	No	No	No	No	No	No	No
d. Other			N/a	N/a	N/a	N/a				
3. **Applicable to TCW jobs only**: Is there the potential for corrosion inhibitors, deemulsifiers, surfactants, defoamers, or biocides to be comingled with TCW wastewaters? If yes, please identify the type:	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a. Corrosion inhibitor:	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. Deemulsifier:	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
c. Surfactants	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
d. Defoamers:	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
e. Biocides:	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
f. Other:			Yes	Yes	Yes	Yes				

Table 3-1
Details of Planned TCW Discharges
Joint Industry Project Study Plan for TCW Discharges
Gulf of Mexico: Western and Central Planning Regions

Historical, Existing or Planned?	Planned	Planned	Planned	Planned	Planned	Pending	Pending
Date or Anticipated Start Date	Q1 2020	Q2 2020	Q4 2020	Q4 2019	Q2 2020	Q3 2020	Q4 2020
SECTION 1. General Information							
1. Area:	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon	Mississippi Canyon
2. Water Column Depth (ft.)	3,030	3,030	3,030	3,798	3,798	3,798	3,798
SECTION 2. Treatment Completion and Workover (TCW) Fluids							
1. What type of well treatment or workover operation is conducted? Please provide a brief description:	Completion	Completion	Completion	Completion	Completion	Completion	Completion
2. What types of TCW fluids are used?	--	--	--	--			
a. Category I	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. Category II	Yes	Yes	Yes	Yes	Yes	Yes	Yes
c. Category III	Yes	Yes	Yes	Yes	Yes	Yes	Yes
d. Category IV	No	No	No	No	No	No	No
e. Other:							
3. Are there jobs where one, or a combination of TCW fluid categories are discharged to surface waters? If yes, proceed to Section 3.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SECTION 3. Discharge of TCW Wastewaters to Surface Water							
1. Are TCW wastewaters commingled and discharged as part of produced water?	No	No	No	No	No	No	No
2. Are TCW wastewaters discharged directly to surface water without treatment or storage in a tank?	No	No	No	No	No	No	No
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	N/A	N/A	N/A	Yes	Yes	Yes	Yes
b. What is the pipe diameter (inches)?	N/A	N/A	N/A	16"	16"	16"	16"
3. Are TCW wastewaters discharged to a tank on the Facility and then discharged overboard?	Yes	Yes	No	No	No	No	No
a. If yes, is a NPDES-designated discharge point used, e.g., pipe?	Yes	Yes	Yes	N/A	N/A	N/A	N/A
b. What is the pipe diameter (inches)?	16"	16"	16"	N/A	N/A	N/A	N/A
4. Are TCW wastewaters discharged via a hose off the tank?	No	No	No	No	No	No	No
a. If yes, what is the hose diameter (inches)?	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5. Are the TCW wastewaters discharged above the ocean surface?	No	No	No	No	No	No	No
a. If yes, at what height above the water column does the discharge occur?				N/A	N/A	N/A	N/A
b. If no, at what water column depth does the discharge occur?	78'	78'	78'	70 ft	70 ft	70 ft	70 ft
6. Typically, how often are TCW wastewaters discharged, e.g., once a week, quarterly?	After passing a sheen test	After passing a sheen test	Zero Discharge / ZnBr2 Fluid	Weekly	Weekly	Weekly	Weekly
7. Typically, what is the duration of the discharge (minutes/hours)?	30	30		<30 minutes	<30 minutes	<30 minutes	<30 minutes
8. Are TCW wastewaters discharged back to the Facility and passed through a filtration system before discharging overboard?	No	No	No	No	No	No	No
a. Do you use a designated discharge point such as a pipe, if so, what is the diameter (in.)?	16"	16"	16"	N/A	N/A	N/A	N/A
b. Do you use a hose off of the Filtration system, if so what is the diameter (in.)?	Yes	Yes		No	No	No	No
c. Are wastewaters discharged via any other structure, e.g., diffuser? If yes, please describe:	No	No	No	No	No	No	No
9. Is any other treatment of TCW wastewaters conducted? If yes, please describe:	Sheen Test	Sheen Test	Sheen Test	No	No	No	No
SECTION 4. Discharge of Other Wastewaters (Zinc Bromide; Acid Jobs; Chemical Additives) to Surface Water							
1. Are zinc bromide wastewaters sent onshore for disposal?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a. If no, how are zinc bromide wastewaters disposed?							
b. Other:							
2. **Applicable to TCW jobs only**: Are acid jobs conducted? If yes, how are acidic wastewaters treated?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a. Do you send onshore for disposal?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. Do you discharge acid job wastewaters directly overboard without treatment?	No	No	No	No	No	No	No
c. Do you neutralize the pH and then discharge overboard?	No	No	No	No	No	No	No
d. Other							
3. **Applicable to TCW jobs only**: Is there the potential for corrosion inhibitors, deemulsifiers, surfactants, defoamers, or biocides to be comingled with TCW wastewaters? If yes, please identify the type:	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a. Corrosion inhibitor:	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. Deemulsifier:	Yes	Yes	Yes	Yes	Yes	Yes	Yes
c. Surfactants	Yes	Yes	Yes	Yes	Yes	Yes	Yes
d. Defoamers:	Yes	Yes	Yes	Yes	Yes	Yes	Yes
e. Biocides:	Yes	Yes	Yes	Yes	Yes	Yes	Yes
f. Other:				TBD	TBD	TBD	TBD

Table 3-2
Overview of TCW Fluid Categories
Joint Industry Project Study Plan for TCW Discharges
Gulf of Mexico: Western and Central Planning Regions

Fluid Type	Definition	Fluid Makeup (Categories I-IV)
Treatment	Any fluid used to remediate a well performance issue after a well has been drilled.	**Category I**: freshwater; seawater; and saltwater brines of variable density **Category II**: organic/inorganic acids; non-reactive fluid systems
	Well treatment fluids are any fluid used to restore or improve productivity by chemically or physically altering hydrocarbon-bearing strata after a well has been drilled (USEPA, 1993).	**Category III**: Hydraulic fracturing fluids (typically formulated from Category I fluids) **Category IV**: Hydrocarbon-based fluids
Completion	Any fluid used in completing a new well.	**Category I**: Typically used; **Category IV**: Rarely used.
	Completion fluids are salt solutions, weighted brines, polymers, and various additives used to prevent damage to the wellbore during operations which prepare the drilled well for hydrocarbon production (USEPA, 1993).	
Workover	Any fluid used in the workover/recompletion/ or abandonment of an existing well.	**Category I:** Typically used; **Category IV:** Rarely used.
	Workover fluids are salt solutions, weighted brines, polymers and other specialty additives used in a producing well to allow safe repair and maintenance or abandonment procedures (USEPA, 1993).	

Notes:

USEPA. 1993. Development Document for Final Effluent Limitations Guidelines and New Source Performance Standards for the Offshore Subcategory of the Oil and Gas Extraction Point Source Category, EPA 821-R-93-003, Office of Water, 407 pp.

Table 4-1
Data Quality Objectives
Joint Industry Project Study Plan for TCW Discharges
Gulf of Mexico: Western and Central Planning Regions

DQO Step		Description	Work Plan Section
Step 1	**State the problem**	Recent analytical or ecotoxicological data are not available to characterize the composition of the TCW fluids and TCW discharges and their potential toxicity towards exposed aquatic biota. These data sets are required consistent with NPDES GP requirements.	**Section 1.0**
Step 2	**Identify study goals**	• **Objective 1**: Characterize the composition, environmental fate characteristics, and aquatic toxicity of key/dominant constituents in TCW fluids. • **Objective 2**: Characterize the composition of TCW discharges and the potential to cause aquatic toxicity.	**Section 1.0**
Step 3	**Identify data and information needed**	Preliminary estimates indicate that 45 TCW operations are planned: 2019 (n=18) and 2020 (n=27). Two types of samples will be collected: (1) discharge samples for chemical analysis, and (2) whole effluent toxicity (WET) test samples. Marine WET test organisms will include *Mysidopsis bahia* (Mysid shrimp) and *Menidia beryllina* (Inland silverside minnow). The WET test endpoint will be lethality: 48-hour NOEC/48-hour LC50.	**Section 3.0; Table 3-1; Section 4.0; Table 4-2; Figures 4-1 through 4-4; Appendix A; Appendix B**
Step 4	**Define study boundaries**	• **Study Area:** Gulf of Mexico (Western and Central planning regions). Primarily USEPA Region 6, with some planned locations along the USEPA Regions 4/6 jurisdictional boundary . • **Timeframe:** Sampling will occur in 2019 and 2020. • **Limitations/Constraints:** There are potential logistical constraints to collecting samples from discharge locations hundreds of miles offshore. There is the potential that sample hold times may be exceeded. Also, the intermittent and short duration of the discharges may complicate sample collection and WET test analysis.	**Section 4.0; Section 6.0; Figures 4-1; 4-2; and 4-4**
Step 5	**Develop the analytic approach and logic for drawing conclusions**	**Objective 1: Characterize the composition, environmental fate characteristics, and aquatic toxicity of dominant constituents in TCW fluids:** • ***TCW fluid composition***: The proposed approach to characterizing TCW fluid composition will be based upon the best available information including JIP participant data; current literature; and publicly available databases. The information will identify the dominant constituents that are currently used in TCW fluids. • ***TCW fluid fate characteristics and potential for aquatic toxicity***: Environmental fate characteristics and the potential aquatic toxicity of TCW fluid constituents will be assessed using publicly available databases. **Objective 2: Characterize the composition of TCW discharges and the potential to cause aquatic toxicity:** • ***TCW discharge composition***: The analytical parameters selected for evaluation may include ions, metals, 16 PAHs; and water quality parameters known to influence bioavailability/aquatic toxicity. The selected analytical parameters exhibit the potential to be present in TCW discharges. Selected analytical parameters will be evaluated at the critical effluent dilution only. • ***Whole effluent toxicity (WET) testing***: An acute, 48-hour static renewal WET test will be conducted. The WET test endpoint will be lethality. The NOEC and LC50 % dilution must be $\geq$ the critical effluent dilution for the WET test to "pass". A statistically significant increase in lethality relative to the control sample occurs when probability $(p)<0.05$. • ***Acute toxicity screening***: An acute toxicity screening with a hazard quotient (HQ) approach will place the data into context and assess the potential for acute aquatic toxicity. The concentration at the critical effluent dilution ($C_{crit.dil.}$) will be compared to published acute saltwater effects benchmarks including species-specific acute saltwater effects benchmarks and acute saltwater aquatic life criteria. An HQ <1 indicates that acute toxicity is not expected because the estimated exposure has not been demonstrated to cause adverse ecological effects. An HQ $\geq$1 generally indicates a potential for acute toxicity because estimated exposure exceeds a known threshold of effects. **Decision Rules** • If the WET test NOEC or LC50 are $\geq$ critical effluent dilution, and HQs are <1, then there is adequate evidence to conclude that TCW discharge constituents are not associated with aquatic toxicity. • If the WET test NOEC or LC50 are < critical effluent dilution, and HQs are $\geq$1, then there is adequate evidence to conclude that TCW discharge constituents may potentially be associated with aquatic toxicity.	**Section 3.0; Section 4.0; Table 3-1 and Table 3-2; Table 4-2; Figures 4-1 through 4-5; Appendix A and Appendix B**
Step 6	**Specify performance or acceptance criteria including probability limits**	**Baseline Condition or Null Hypothesis (H_o)** • There is no statistically significant difference in the acute lethality of WET test organisms exposed to TCW discharges and the laboratory control. • Observed acute toxicity is not associated with the constituents in TCW discharges, i.e., HQ<1. **Type I and II error and tolerance level:** An incorrect decision can be made by determining that a sample is toxic when in fact it is not (Type **I** error), or determining that a sample is not toxic when in fact it is (Type **II** error). Type **I** error is more important in the current situation: • Type **I** (α) = 0.05 (5%) probability of identifying toxicity, when H_o is true. • Type **II** (β) = 0.2 (20%) probability of not identifying toxicity, when H_o is false.	**Section 4.0; Appendix B**
Step 7	**Develop the plan for obtaining data**	The SAP presents the approach to generating data that meet the DQOs and decision performance goals developed in Steps 1 through 6 of the DQO Process. The JIP plan also includes a quality assurance project plan (QAPP) that provides guidance for collecting the analytical data necessary to meet the DQOs.	**Sections 1.0 through 8.0; Tables 2-1, 3-1 through 3-2; 4-1 through 4-3; Figures 3-1, and 4-1 through 4-5; Appendices A and B.**

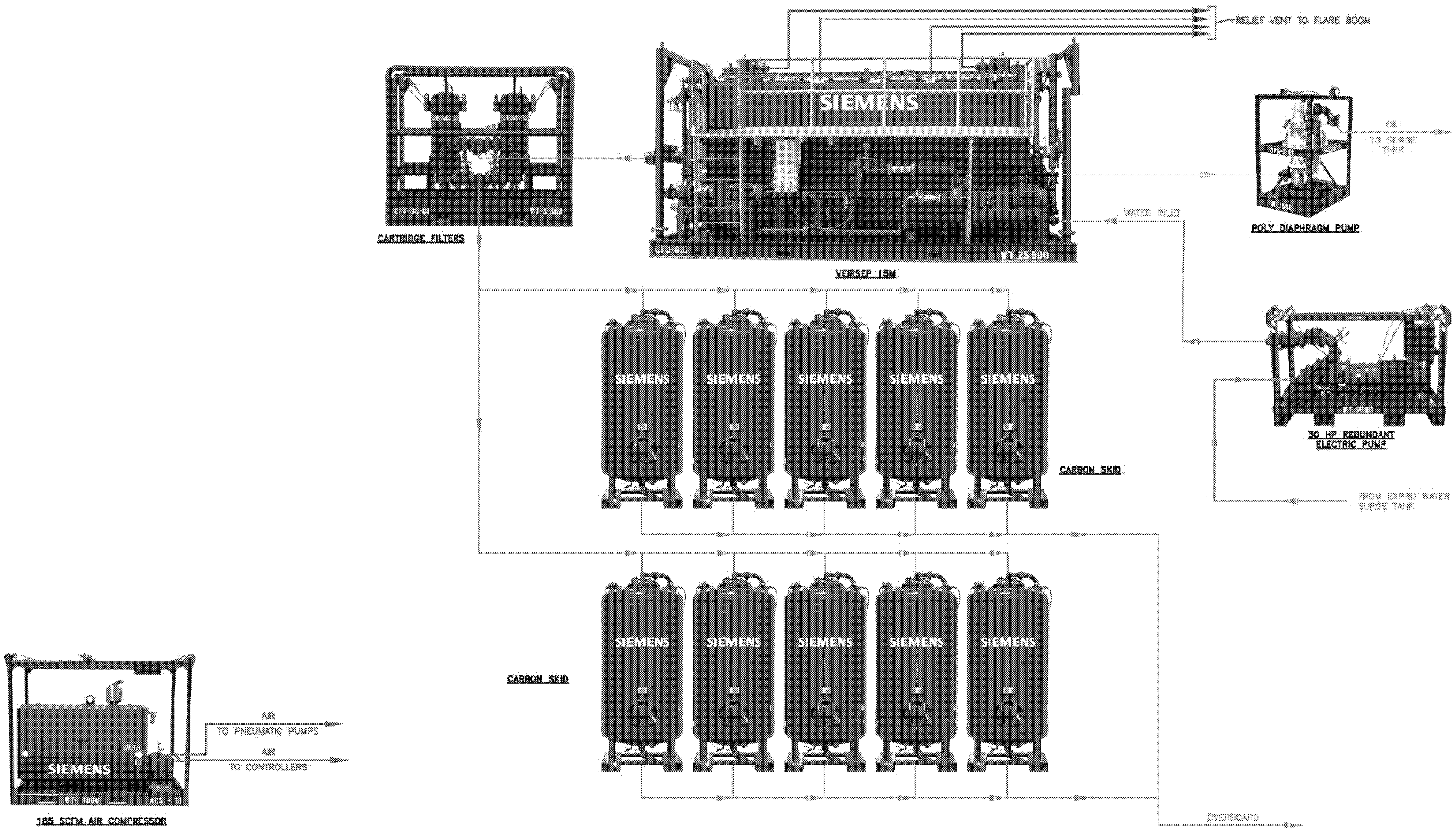
Table 4-2
Schedule for Planned TCW Discharges
Joint Industry Project Study Plan for TCW Discharges
Gulf of Mexico: Western and Central Planning Regions

Year	Quarter	Area
2019	1	Viosca Knoll
	1	Ewing Bank
	1	Ewing Bank
	1	Ewing Bank
	1	Ewing Bank
	1	Ewing Bank
	2	High Island
	2	Ship Shoal 28
	2	Ship Shoal 349
	2	Mississippi Canyon
	2	Mississippi Canyon
	2	Mississippi Canyon
	2	Walker Ridge
	2	Mississippi Canyon
	2	Mississippi Canyon
	2	Mississippi Canyon
	2	Mississippi Canyon
	2	Garden Banks
	2	Mississippi Canyon
	2	Mississippi Canyon
	3	Green Canyon
	3	Mississippi Canyon
	3	Mississippi Canyon
	3	Mississippi Canyon
	3	Mississippi Canyon
	3	Mississippi Canyon
	3	Mississippi Canyon
	3	Mississippi Canyon
	3	Mississippi Canyon
	4	Green Canyon
	4	Mississippi Canyon
	4	Mississippi Canyon
	4	Mississippi Canyon
	4	Mississippi Canyon
	4	Mississippi Canyon
	4	Mississippi Canyon
2020	1	Mississippi Canyon
	1	Mississippi Canyon
	1	Mississippi Canyon
	1	Alaminos Canyon
	1	Alaminos Canyon
	1	Mississippi Canyon
	2	Green Canyon
	2	Mississippi Canyon
	2	Mississippi Canyon
	2	Walker Ridge
	2	Mississippi Canyon
	2	Mississippi Canyon
	2	Mississippi Canyon
	2	Mississippi Canyon
	3	Mississippi Canyon
	3	Mississippi Canyon
	3	Alaminos Canyon
	3	Alaminos Canyon
	3	Mississippi Canyon
	3	Mississippi Canyon
	3	Alaminos Canyon
	3	Mississippi Canyon
	4	Mississippi Canyon
	4	Mississippi Canyon
	4	Alaminos Canyon
	4	Mississippi Canyon
	4	Garden Banks
	4	Garden Banks
	4	Mississippi Canyon
	4	Mississippi Canyon

Table 4-3
Summary of QAPP Components
Joint Industry Project Study Plan for TCW Discharges
Gulf of Mexico: Western and Central Planning Regions

QAPP Worksheets	Description
#1 & 2: Title and Approval Page	This worksheet identifies the principal points of contact for all organizations having decision authority in the project and documents their commitment to implement the QAPP. Signatures indicate that the individuals have reviewed the QAPP and concur with its implementation as written.
#3 & 5: Project Organization and QAPP Distribution	This worksheet identifies key project personnel, as well as lines of authority and lines of communication among the lead agency, prime contractor, subcontractors, and regulatory agencies. For the purpose of this draft QAPP, it is permissible to show "TBD" in cases where roles have not been assigned; all key personnel, however, will be identified in the final, approved QAPP.
#4, 7 & 8: Personnel Qualifications and Sign-off Sheet	This worksheet identifies key project personnel for each organization performing tasks defined in the QAPP.
#6: Communication Pathways	This worksheet documents specific issues that will trigger the need to communicate with other project personnel or stakeholders. Its purpose is to ensure there are procedures in place for providing the appropriate notifications and generating the appropriate documentation when handling important communications, including those involving regulatory interfaces, unexpected events, emergencies, non-conformances, and stop-work orders.
#9: Project Planning Session Summary	This worksheet provides a concise record of participants, key decisions or agreements reached, and action items.
#10: Conceptual Site Model	This worksheet is used to present the project's conceptual site model (CSM). The CSM is a tool that was used to assist in the development of the JIP study DQOs.
#11: Project/Data Quality Objectives	This worksheet presents the DQOs.
#12: Measurement Performance Criteria	This worksheet documents the quantitative measurement performance criteria (MPC) in terms of precision, bias, and sensitivity for both field and laboratory measurements and is used to guide the selection of appropriate measurement techniques and analytical methods. MPC are developed to ensure collected data will satisfy the JIP study DQOs.
#13: Secondary Data Uses and Limitations	This worksheet is used to identify sources of secondary data, i.e., data generated for purposes other than this specific project.
#14/16: Project Tasks & Schedule	This worksheet presents the sampling schedule showing specific tasks, the person or group responsible for their execution, and planned start and end dates.
#15: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits	The purpose of this worksheet is to make sure the selected analytical laboratory and method can provide accurate data with known precision and bias.
#17: Sampling Design and Rationale	This worksheet was used to describe the sampling design and the basis for its selection. It documents the last step of the systematic planning process.
#18: Sampling Locations and Methods	This worksheet serves as a completeness check for field personnel and auditors/assessors. It facilitates checks to make sure all planned samples have been collected and appropriate methods have been used.
#19 and 30: Sample Containers, Preservation, and Hold Times	This worksheet serves as a reference guide and an aid to completing the CoC form and shipping documents. Laboratory accreditation/certification is required for JIP study; hence, laboratory accreditation/certification status for each analyte/matrix/method combination is identified.
#20: Field QC Summary	This worksheet provides a summary of the types of samples to be collected and analyzed for the project. Its purpose is to show the relationship between the number of field samples and associated QC samples for each combination of analyte/analytical group and matrix.
#21: Field SOPs	This worksheet documents the specific field procedures being implemented, which is important for measurement traceability.
#22: Field Equipment Calibration, Maintenance, Testing, and Inspection	Not applicable - was not included in QAPP.
#23: Analytical SOPs	This worksheet documents information about the specific sample preparation and analytical procedures to be used, which is important for measurement traceability. Screening data are used for interim investigations and/or will not be used for final risk assessment or site assessment decisions unless they have been confirmed with definitive procedures. SOPs for all sample preparation and analytical procedures must be current and referenced whether these activities are performed in the field or in an off-site laboratory.
#24: Analytical Instrument Calibration	This worksheet was completed for all analytical instruments, whether used in the field or the laboratory. As appropriate to the instrument, calibration procedures include tuning, initial calibration, calibration blank, initial calibration verification (second source), continuing calibration verification, linear dynamic range, and verification of detection and quantification limits.
#25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection	This worksheet identifies the following: instrument /equipment maintenance activity; testing activity; inspection activity; frequency; acceptance criteria; corrective action; and title/position of individual responsible for corrective action.
#26 & 27: Sample Handling, Custody, and Disposal	This worksheet is documents responsibilities for maintaining custody of samples from sample collection through disposal. The information in this worksheet table is referenced to the wastewater sampling SOP.
#28: Analytical Quality Control and Corrective Action	The purpose of this worksheet is to ensure that the selected analytical methods are capable of meeting project-specific DQOs. If method/SOP QC acceptance criteria do not meet the project-specific DQOs, the data obtained may be unusable for making reliable project decisions.
#29: Project Documents and Records	This worksheet describes the process of recording information for all documents and records that will be generated for the project.
#31, 32 & 33: Assessments and Corrective Action	This worksheet documents responsibilities for conducting project assessments, responding to assessment findings and implementing corrective action. Appropriately scheduled assessments at the beginning of sampling allow management to implement corrective action in a timely manner, thereby correcting non-conformances and minimizing their impact on the DQOs.
#34: Data Verification and Validation Inputs	This worksheet lists the inputs that will be used during data verification and validation. Inputs include planning documents, field records, and laboratory records. Data verification is a check that all specified activities involved in collecting and analyzing samples have been completed and documented and that the necessary records are available to proceed to data validation.
#35: Data Verification Procedures	This worksheet documents procedures that will be used to verify project data. It applies to both field and laboratory records. Data verification is a completeness check to confirm that all required activities were conducted, all specified records are present, and the contents of the records are complete. As illustrated in the following example, verification often is performed at more than one step by more than one person.
#36: Data Validation Procedures	This worksheet documents procedures that will be used to validate project data. Data validation is an analyte and sample-specific process for evaluating compliance with contract requirements, methods/SOPs, and MPC.
#37: Data Usability Assessment	This worksheet documents procedures that will be used to perform the data usability assessment. The data usability assessment is performed at the conclusion of data collection activities, using the outputs from data verification and data validation. It is the data interpretation phase, which involves a qualitative and quantitative evaluation of environmental data to determine if the project data are of the right type, quality, and quantity to support the decisions that need to be made. It involves a retrospective evaluation of the systematic planning process, and, like the systematic planning process, involves participation by key members of the project team. The data usability assessment evaluates whether underlying assumptions used during systematic planning are supported, sources of uncertainty have been accounted for and are acceptable, data are representative of the population of interest, and the results can be used as intended, with the acceptable level of confidence.

Figures



Legend

- Water
- Oil
- Vent/Relief
- Air

Note:

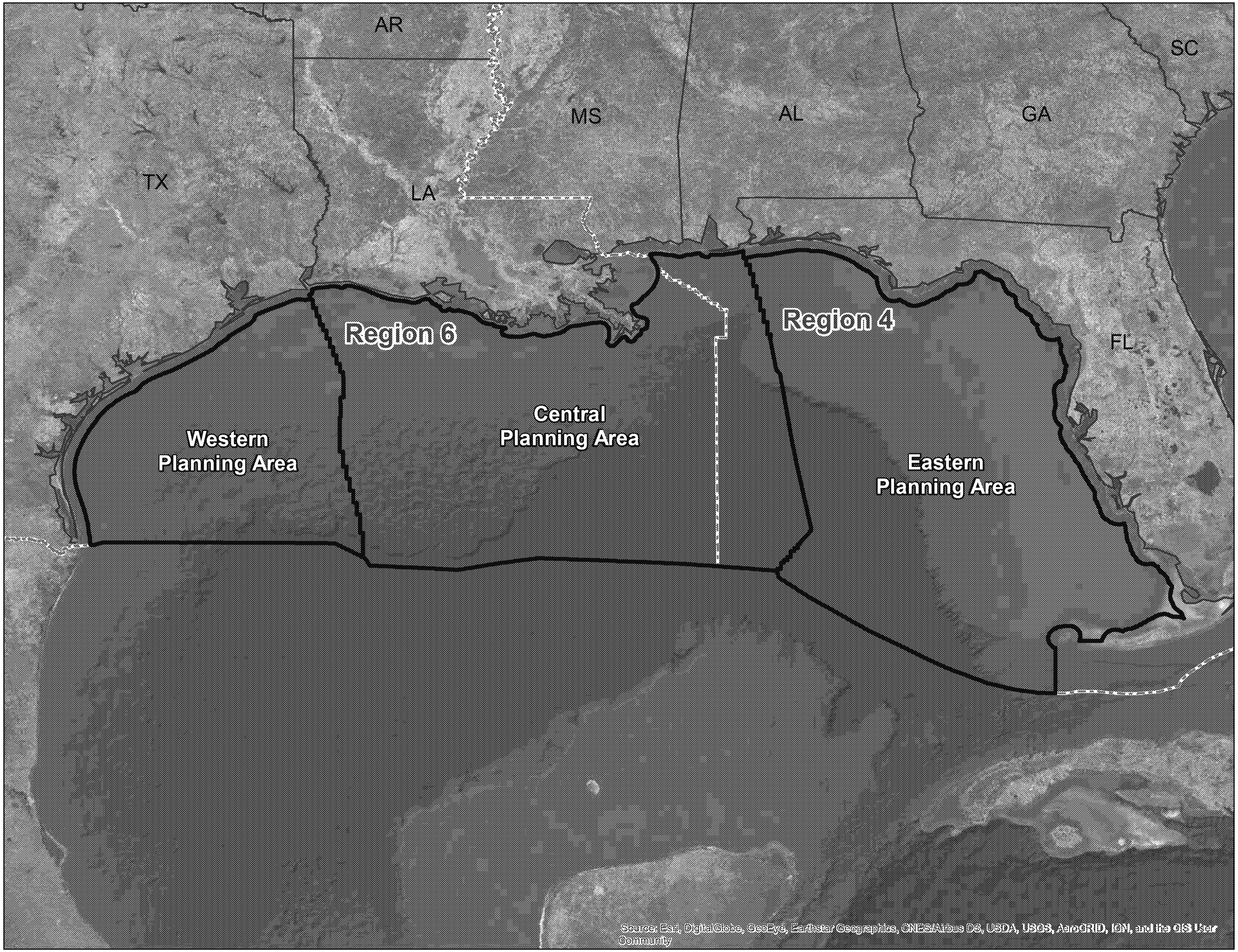
- Diagram created by Siemens Energy, Inc.

Figure 3-1
Typical Well Flowback Process Flow Diagram

Joint Industry Project Study Plan for Treatment, Completion, and Workover TCW Discharges

Gulf of Mexico: Western and Central Planning Regions
USEPA Region 4 NPDES General Permit No. GEG460000
USEPA Region 6 NPDES General Permit No. GMG290000

Prepared By: NAB	Checked By: JJP
Job Number:	Date: 3/7/2019



Legend

Gulf of Mexico Planning Area

USEPA Region Boundaries

References:
-EPA Region Boundaries Exclusive Economic Zone (EPA 2012)
-BOEM Planning Areas (BOEM, Oct 2017)
-Bathymetry Mosaic (NOAA, Apr 2017)

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Figure 4-1
Gulf of Mexico Study Area

Joint Industry Project Study Plan for Treatment, Completion, and Workover TCW Discharges

Gulf of Mexico: Western and Central Planning Regions
USEPA Region 4 NPDES General Permit No. GEG460000
USEPA Region 6 NPDES General Permit No. GMG290000

Prepared By: NAB	Checked By: JJP
Job Number:	Date: 1/18/2019

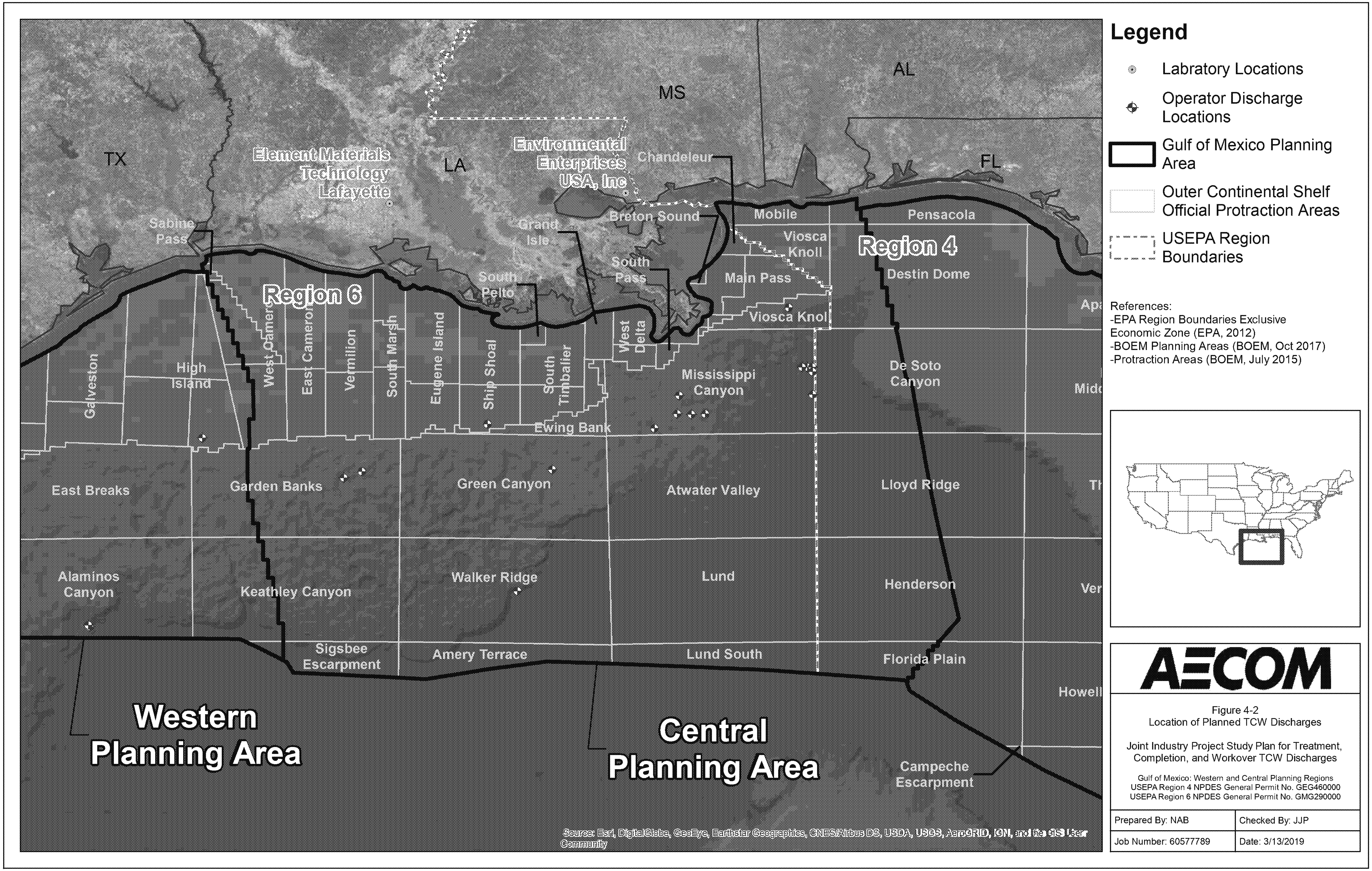
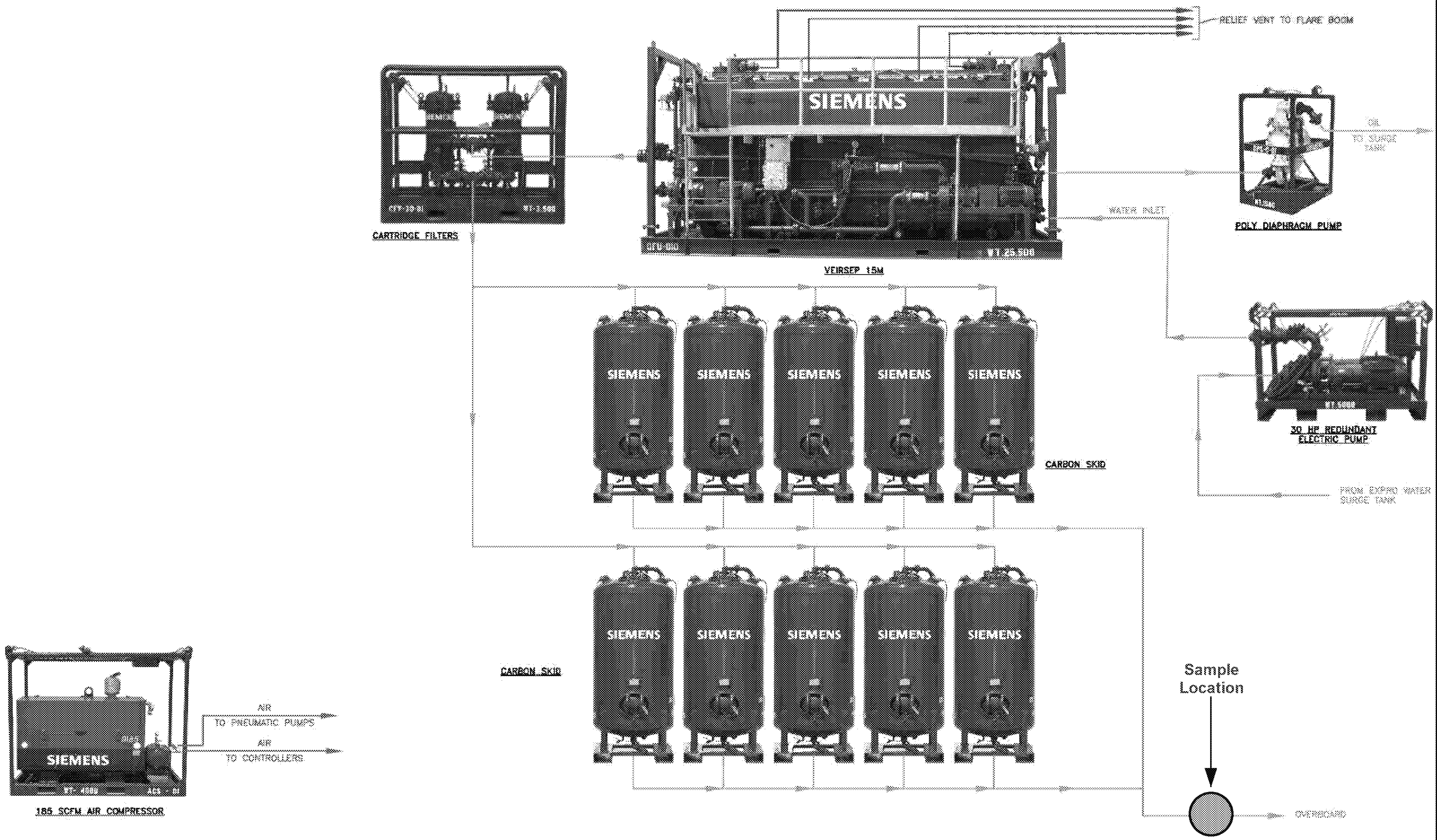


Figure 4-2
Location of Planned TCW Discharges

Joint Industry Project Study Plan for Treatment, Completion, and Workover TCW Discharges

Gulf of Mexico: Western and Central Planning Regions
USEPA Region 4 NPDES General Permit No. GEG460000
USEPA Region 6 NPDES General Permit No. GMG290000



Legend

- Water
- Oil
- Vent/Relief
- Air

Note:

- Diagram created by Siemens Energy, Inc.

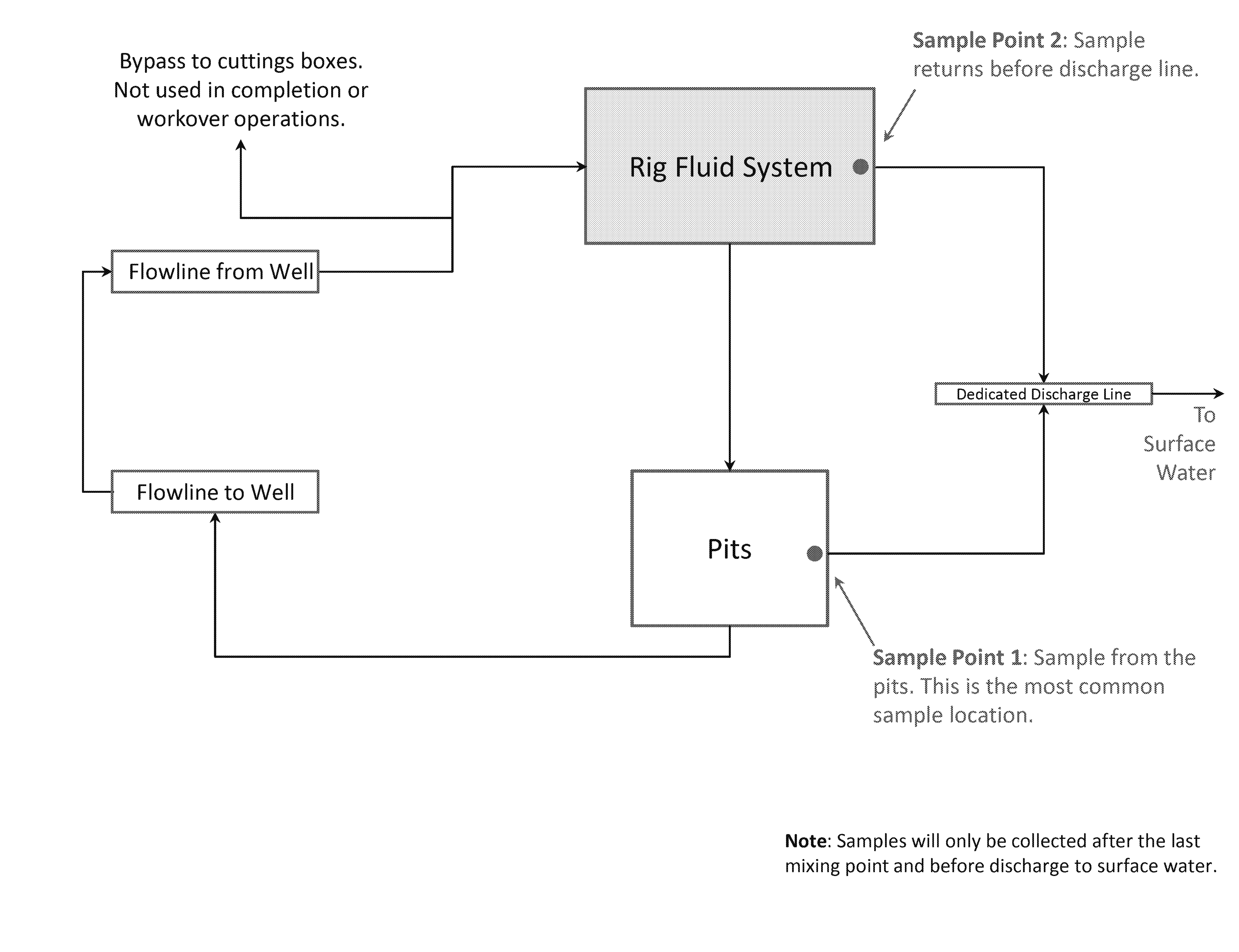
AECOM

Figure 4-3
Typical TCW Discharge Sample Location
(with Treatment)

Joint Industry Project Study Plan for Treatment, Completion, and Workover TCW Discharges

Gulf of Mexico: Western and Central Planning Regions
USEPA Region 4 NPDES General Permit No. GEG460000
USEPA Region 6 NPDES General Permit No. GMG290000

Prepared By: NAB	Checked By: JJP
Job Number:	Date: 3/7/2019



Legend

● Sample Location

Note: Typical TCW Return Path Diagram provided by Shell.

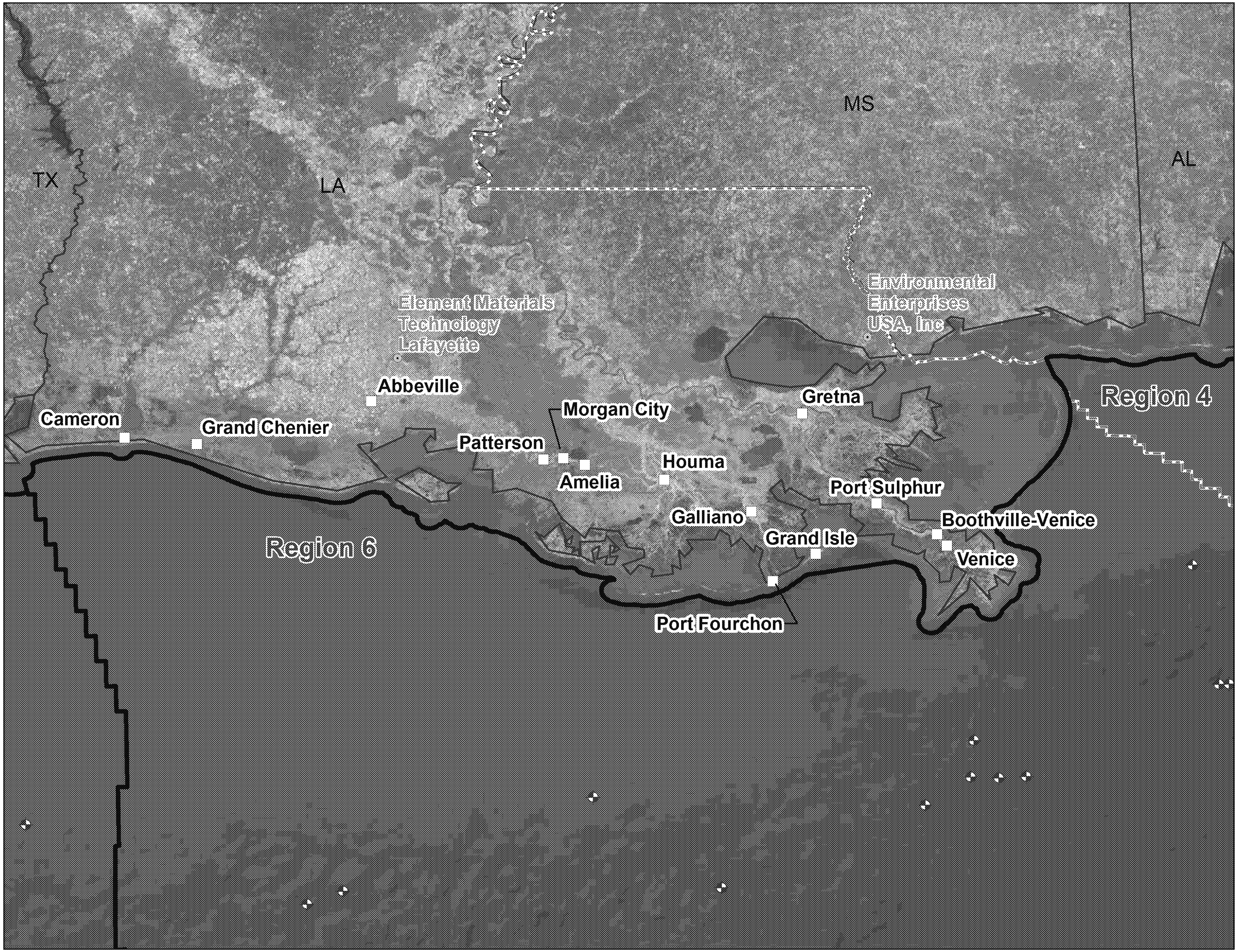
AECOM

Figure 4-4
Typical TCW Discharge Sample Location
(without Treatment)

Joint Industry Project Study Plan for Treatment, Completion, and Workover TCW Discharges

Gulf of Mexico: Western and Central Planning Regions
USEPA Region 4 NPDES General Permit No. GEG460000
USEPA Region 6 NPDES General Permit No. GMG290000

Prepared By: NAB	Checked By: JJP
Job Number:	Date: 3/13/2019



Legend

- Labratory Locations
- Operator Discharge Locations
- Sample Dropoff Locations
- Gulf of Mexico Planning Area
- USEPA Region Boundaries

References:
-EPA Region Boundaries Exclusive Economic Zone (EPA, 2012)
-BOEM Planning Areas (BOEM, Oct 2017)
-Protraction Areas (BOEM, July 2015)

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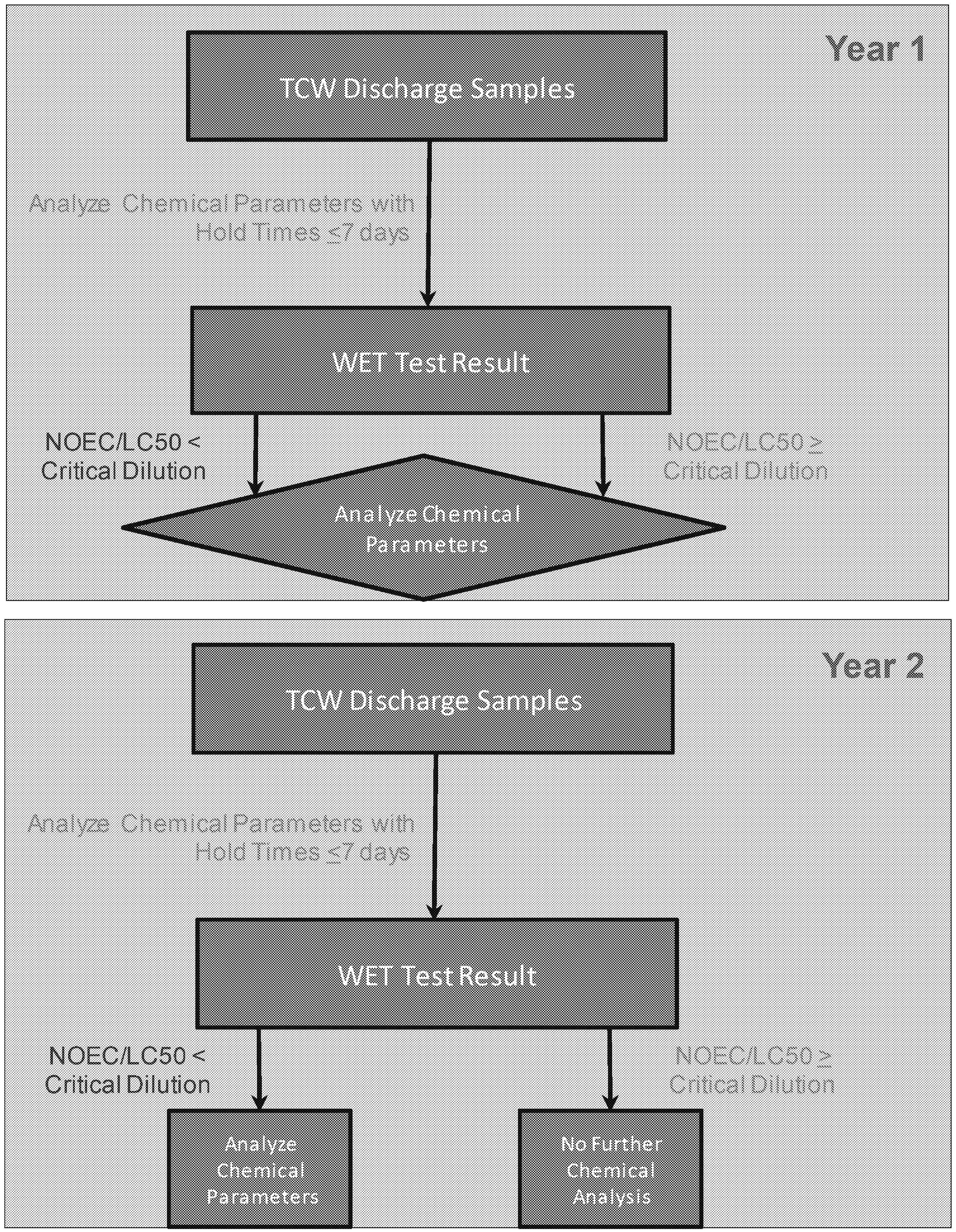
Figure 4-5
Locations of Shore Bases

Joint Industry Project Study Plan for Treatment, Completion, and Workover TCW Discharges

Gulf of Mexico: Western and Central Planning Regions
USEPA Region 4 NPDES General Permit No. GEG460000
USEPA Region 6 NPDES General Permit No. GMG290000

Prepared By: NAB	Checked By: JJP
Job Number:	Date: 3/14/2019



Legend

- LC50: 50 Percent Lethal Concentration
- NOEC: No Observed Effect Concentration
- WET: Whole Effluent Toxicity

AECOM

Figure 4-6
Adaptive Approach for Laboratory Analytical Parameters

Joint Industry Project Study Plan for Treatment, Completion, and Workover TCW Discharges

Gulf of Mexico: Western and Central Planning Regions
USEPA Region 4 NPDES General Permit No. GEG460000
USEPA Region 6 NPDES General Permit No. GMG290000

Prepared By: NAB	Checked By: JJP
Job Number:	Date: 3/7/2019

Appendices

Appendix A TCW Discharge Sampling Standard Operating Procedure

TCW Discharge Sampling
Standard Operating Procedure (SOP)

Joint Industry Project Study Plan:
Treatment, Completion, and Workover Discharges
Gulf of Mexico: Western and Central Planning Regions

Purpose

The purpose of this treatment, completion, and workover (TCW) discharge sample standard operating procedure (SOP) is to provide guidance for the collection and handling of TCW discharge samples. Sampling of TCW discharges is being conducted in support of a joint industry project (JIP) study. This SOP describes a five-step process that is to be used to ensure that representative TCW discharge samples are collected. The five steps include: (**1**) conduct a pre-sampling meeting; (**2**) check sampling equipment; (**3**) identify the sampling location; (**4**) collect the samples; and (**5**) complete sample labeling and shipping. Technical guidance documents used in the development of this SOP include:

- USEPA. 2017. *Operating Procedure: Wastewater Sampling*. SESDPROC-306-R3. USEPA Region 4; February 13, 2017.

Sample Types

TCW discharge samples will be evaluated for: (1) acute 48-hour WET testing; and (2) chemical analysis.[1]

Analytical Laboratories

Analytical laboratories are identified below, along with contact information and responsibilities:

Laboratory	Abbreviation	Contact Information	Responsibility
Environmental Enterprises USA, Inc.	EEUSA	David Daniel President/Laboratory Manager Email: ddaniel@eeusa.com Cell: (985) 707-5442 Anytime: (800) 966-2787	WET testing; preparation of samples at the critical effluent dilution for chemical analysis
Element Materials Technology Lafayette	EMTL	Cristina Thibeaux Project Manager TEL: (337) 235-0483 2417 W. Pinhook Road Lafayette, LA 70508-3344 Website: www.element.com	Chemical analysis of prepared samples

STEP 1. Hold a Pre-Sampling Meeting

The pre-sampling meeting will determine:

- The availability of trained individuals designated to collect samples.
- The proper chain of custody (CoC) procedures for collected samples.

- Those individuals responsible for completing and handling the chain of custody.
- The number of samples to be collected during the project.
- The job's discharge criteria.
- What parameters to test for in each sample.

STEP 2. Check the Sampling Equipment

- Pre-labeled sample containers will be sent by EEUSA to an Operator contact/shore base. This includes quality assurance / quality control (QA/QC) samples.
- Logbook/data sheets.
- PPE: flotation device; nitrile/protective gloves; hard hat; wraparound safety glasses; ear protection; steel-toed boots; high visibility vest; coveralls/long sleeve shirt and pants.

STEP 3. Identify the Sampling Location

The sampling location will be situated after final treatment (where applicable) and before discharge to surface waters via the overboard discharge line. Almost all platforms have a discharge valve or sample port on the overboard discharge line to sample discharges.

STEP 4. Collect the Samples

Grab samples will be collected at the beginning of the discharge. An overview of sample collection is provided below:

- Upon arrival at the discharge location, the designated individual(s) will ensure that the proper sample containers are present. Field investigators must use new, verified certified-clean disposable or non-disposable equipment for collection of samples for organic compound analyses. Fill out the data sheet.

- During sample collection it is important to wear protective gloves (minimum) as well as a face shield and an apron (when fluid is deemed particularly hazardous) in order to ensure proper protection. A clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised.

- The designated individual(s) will collect samples in proper containers once liquids are available for sampling. To collect a sample:

    - Flush the sample port for 15 seconds into a sump/catch basin. Maintain a slow, steady stream – do not spray or spill effluent in the work area when flushing the sample port.

    - Unpreserved, pre-labeled sample containers will be provided by EEUSA. Fill the sample containers; there should be zero headspace. Collect quality assurance/quality control (QA/QC) samples as necessary, e.g., trip blank (pre-sent from laboratory); field duplicate; matrix spike (MS); and matrix spike duplicate (MSD).

- After filling all sample containers, close the sample port.

STEP 5. Complete Sample Labeling and Shipping

- **Sample identification:** Sample identification is provided below:

  All collected samples will be pre-labeled clearly and precisely by EEUSA for proper identification in the field and for tracking in the laboratory. The samples will have pre-assigned, identifiable, and unique numbers. At a minimum, the sample labels will contain the following information: sample number; date of collection; analytical parameter(s); and method of preservation. Every sample will be assigned a unique sample number and will include:

JIP Study – Area – Block – American Petroleum Institute (API) Well Number – TCW Discharge – Sample Event Number

- **Custody seal**: Samples should be sealed with a custody seal:
  - The custody seal should be completely filled out.
  - The custody seal should be initialed by the responsible party.
  - The custody seal should be applied properly, with one "Seal" end on the top of the sample container, and the other "Seal" end running down the side of the container.
- **Chain of Custody (CoC)**: The sampler will complete a CoC to include the following information:
  - Customer/company name.
  - Project name.
  - Sampler's name.
  - Contact phone numbers.
  - Number of samples.
  - Description of samples.
  - Dates and times samples were taken.
  - What tests are to be conducted.
  - Date/time laboratory report is due; note when rush sample analysis is required.

  - Completed data sheet.

- **Sample hold time**: Sample hold time is **36 hours**.

- **Sample shipping**: Call EEUSA **24 hours in advance**. Samples will be shipped to EEUSA where sub-sampling will be performed; EEUSA will ship the samples for chemical analysis to EMTL. Samples will be packed in ice and placed in a cooler for shipping. Pack ice in freezer bags; do not use chemical ice packs.

  The designated sampler will transfer the samples and the CoC to the individual designated to submit the samples to the laboratory. The sampler will ensure that the individual designated to submit the samples to the lab has read and signed the CoC, and understands the responsibility of taking charge of the samples. The sampler will record the name of the individual taking custody of the samples for future reference. The individual taking custody of the samples will deliver the samples to the laboratory. The lab will always be the last custodian of the samples and shall sign for them on the CoC. Shipped samples will conform to all U.S. Department of Transportation (DOT) hazardous materials shipping requirements.

  Sample coolers will be delivered to sample drop-off locations, e.g., shore bases/heliports. EEUSA will drop off empty sample kits and pick up samples Monday through Friday. Operators will use their own local address for the sample pickup/drop-off locations identified below, e.g., dock space, heliport, or an Operator-owned Facility. Ideally sample drop-off would be coordinated with routine transportation, i.e., a shift-change. If this is not practical, the samples will be "hot-shot" via helicopter to meet sample hold time requirements. Sample drop-off locations are provided below:

Day	Shore Base Location	Time
Tuesday	Grand Isle, LA Port Fourchon, LA Leeville, LA Galliano, LA	0930 1100 1130 1230
Wednesday	Venice, LA Boothville, LA Port Sulphur, LA Gretna, LA Patterson, LA Morgan City & Amelia, LA Houma, LA	1030 1100 1200 1330 0900 1000 1100
Thursday	Grand Isle, LA Port Fourchon, LA Leeville, LA Galliano, LA Cameron & Creole, LA Grand Chenier, LA Abbeville/ICY, LA	0930 1100 1130 1230 1000 1030 1230
Friday	Patterson, LA Morgan City & Amelia, LA Houma, LA	0900 1000 1100

Appendix B
Quality Assurance Project Plan

QAPP Worksheet #1 & 2: Title and Approval Page
(UFP-QAPP Manual Section 2.1)
(EPA 2106-G-05 Section 2.2.1)

1. **Project Identifying Information**
    a. **Site name/project name:** Treatment Completion and Workover (TCW) Fluids Water Characterization Study
    b. **Site location/number:** Western and Central Gulf of Mexico Outer Continental Shelf (OCS)
    c. **AECOM Project Number:** 60577789

2. **Lead Organizations:** Offshore Operators Committee (OOC)
AECOM
Marine Ventures International (MVI)

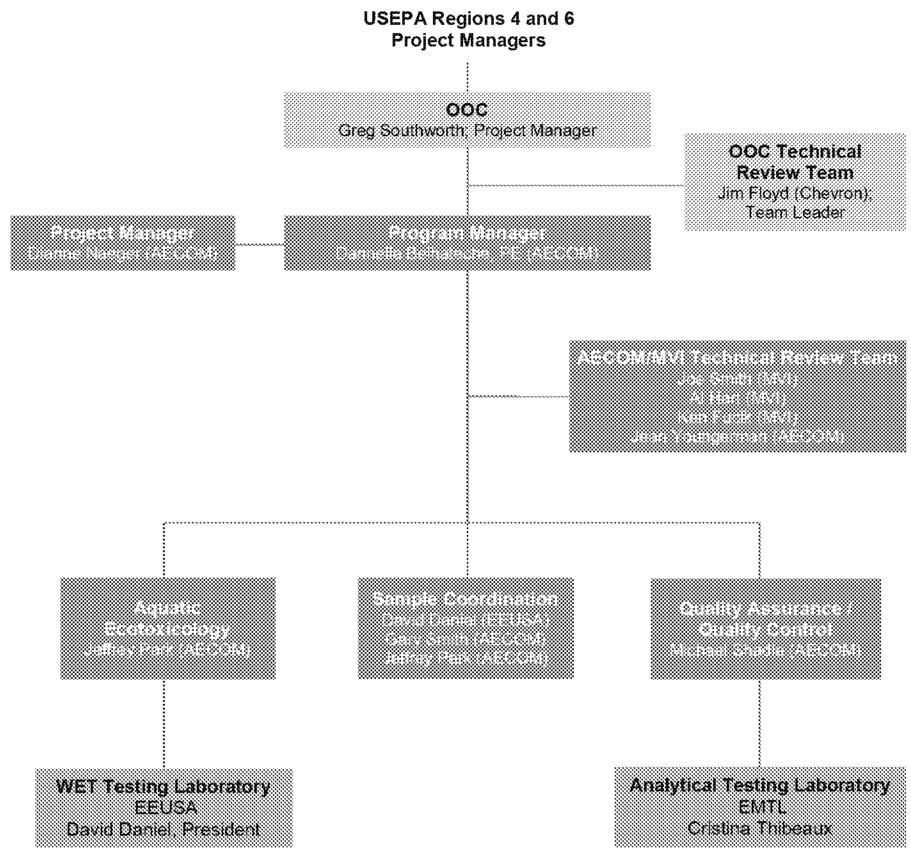
3. **Federal Regulatory Agencies:** USEPA Region 4
USEPA Region 6

Greg Southworth, Project Manager, OOC	Date
Dannelle H. Belhateche, Program Manager, AECOM	Date
Ken Fucik, Project Manager, MVI	Date
Jeffrey Park, Aquatic Ecotoxicologist, AECOM	Date
Michael Shadle, Quality Assurance Officer, AECOM	Date
Cristina Thibeaux, Laboratory Project Manager, Element Materials Technology Lafayette (EMTL)	Date

David Daniel, Laboratory Project Manager, Environmental Enterprises USA, Inc. (EEUSA)	Date
Kerrie-Jo Robinson-Shell, USEPA Region 4	Date
Isaac Chen, USEPA Region 6	Date

QAPP Worksheet #3 & 5: Project Organization and QAPP Distribution
(UFP-QAPP Manual Section 2.3 and 2.4)
(EPA 2106-G-05 Section 2.2.3 and 2.2.4)

Lines of authority ___________________ Lines of Communication ---------------------------



QAPP Worksheet #4, 7 & 8: Personnel Qualifications and Sign-off Sheet
(UFP-QAPP Manual Sections 2.3.2 – 2.3.4)
(EPA 2106-G-05 Section 2.2.1 and 2.2.7)

ORGANIZATION: **OOC**

Name	Project Title/Role	Signature/Date*
Greg Southworth	Committee Project Manager	

ORGANIZATION: **USEPA**

Name	Project Title/Role	Signature/Date*
Kerrie-Jo Robinson-Shell	USEPA Region 4	
Isaac Chen	USEPA Region 6	

ORGANIZATION: **AECOM**

Name	Project Title/Role	Signature/Date*
Dannelle Belhateche, PE	Program Manager	
Jeffrey Park	Aquatic Ecotoxicologist	
Michael Shadle	Quality Assurance Officer	

ORGANIZATION: **MVI**

Name	Project Title/Role	Signature/Date*
Ken Fucik	Project Manager	

ORGANIZATION: **CHEMICAL AND BIOLOGICAL LABORATORIES**

Name	Project Title/Role	Signature/Date*
Cristina Thibeaux, EMTL	Project Manager	
David Daniel, EEUSA	President	

*Signatures indicate personnel have read and agree to implement this QAPP as written.

QAPP Worksheet #6: Communication Pathways
(UFP-QAPP Manual Section 2.4.2)
(EPA 2106-G-05 Section 2.2.4)

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathway, documentation, etc.)
Regulatory agency interface	USEPA Region 4 and USEPA Region 6/OOC/AECOM	Kerrie-Jo Robinson-Shell and Isaac Chen/Greg Southworth/ Dannelle Belhateche	USEPA Region 4 Chen.Isaac@epa.gov greg@southworthconsulting.com Dannelle.Belhateche@aecom.com	Communication between USEPA, AECOM, and OOC via phone calls and emails
Sample Scheduling	AECOM/Operators/labs	Jeffrey Park/Michael Shadle/ Gary Smith/Labs	Jeffrey.Park@aecom.com Michael.Shadle@aecom.com gary.w.smith@aecom.com Cristina.Thibeaux@element.com ddaniel@eeusa.com Operators (TBD)	Communication between Project Manager, QAO, laboratories and Operators via phone calls and emails
Sample Collection	Operators/AECOM	Michael Shadle/Jeffrey Park/Operators	Jeffrey.Park@aecom.com Michael.Shadle@aecom.com gary.w.smith@aecom.com ddaniel@eeusa.com Operators (TBD)	Communication between AECOM and Operators via phone calls and emails will be documented in emails
Field progress reports	Operators/OOC/AECOM	Greg Southworth / Jeffrey Park/ Dannelle Belhateche/Operators	greg@southworthconsulting.com Dannelle.Belhateche@aecom.com Jeffrey.Park@aecom.com Operators (TBD)	Communication between OOC, AECOM and Operators via emails

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathway, documentation, etc.)
Stop work due to safety issues	OOC/AECOM/Operators	Operators	greg@southworthconsulting.com Dannelle.Belhateche@aecom.com Jeffrey.Park@aecom.com Operators (TBD)	As needed, phone calls between OOC, Project Manager and Operators and documented in emails.
Sample submission/receipt	Operators/AECOM/Labs	Operators/ Michael Shadle/ Jeffrey Park/Labs	Jeffrey.Park@aecom.com Michael.Shadle@aecom.com Cristina.Thibeaux@element.com ddaniel@eeusa.com Operators (TBD)	Communication via emails, phone calls between Operators, QA Officer, Project Manager, and laboratories
Sample receipt variances	Labs/AECOM/Operators	Operators/Michael Shadle/ Jeffrey Park/Labs	Jeffrey.Park@aecom.com Michael.Shadle@aecom.com Cristina.Thibeaux@element.com ddaniel@eeusa.com Operators (TBD)	Communication via emails, phone calls between Project Manager, QA Officer, Operators, and laboratories.
Laboratory quality control variances	AECOM/Labs	Greg Southworth/ Dannelle Belhateche/ Michael Shadle/Labs	greg@southworthconsulting.com Dannelle.Belhateche@aecom.com Michael.Shadle@aecom.com Cristina.Thibeaux@element.com ddaniel@eeusa.com	Communication via emails, phone calls between OOC, QA Officer, Program Manager, and laboratories
Analytical corrective actions	AECOM/Labs	Dannelle Belhateche/ Michael Shadle/Labs	Dannelle.Belhateche@aecom.com Michael.Shadle@aecom.com Cristina.Thibeaux@element.com ddaniel@eeusa.com	Communication via emails, phone calls between Program Manager, QA Officer and laboratory

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathway, documentation, etc.)
Data verification issues, e.g., incomplete records	AECOM/Labs	Dannelle Belhateche/ Michael Shadle/Labs	Dannelle.Belhateche@aecom.com Michael.Shadle@aecom.com Cristina.Thibeaux@element.com ddaniel@eeusa.com	Communication via emails, phone calls between QA officer, Program Manager, and laboratories
Data validation issues, e.g., non-compliance with procedures	AECOM/Labs	Dannelle Belhateche/ Michael Shadle/Labs	Dannelle.Belhateche@aecom.com Michael.Shadle@aecom.com Cristina.Thibeaux@element.com	Communication via emails, phone calls between QA officer, Program Manager , and laboratory
Data review corrective actions	Operators/OOC/AECOM/Labs	Greg Southworth/ Operators/Dannelle Belhateche/Michael Shadle/Jeffrey Park/Labs	greg@southworthconsulting.com Dannelle.Belhateche@aecom.com Jeffrey.Park@aecom.com Michael.Shadle@aecom.com Cristina.Thibeaux@element.com ddaniel@eeusa.com Operators (TBD)	Communication via emails, phone calls between OOC, QA Officer, Program Manager, Project Manager and laboratories

QAPP Worksheet #9: Project Planning Session Summary
(UFP-QAPP Manual Section 2.5.1 and Figures 9-12)
(EPA 2106-G-05 Section 2.2.5)

Date of planning session: After generation of draft QAPP (September 28, 2018) and subsequent iterations of draft QAPP prior to finalization
Location: At respective offices of all participants
Purpose: QAPP Review

Participants:

Name	Organization	Title/Role	Email/Phone
Michael Shadle	AECOM	Quality Assurance Officer	Michael.shadle@aecom.com (804) 290-2488
Jeffrey Park	AECOM	Aquatic Ecotoxicologist	Jeffrey.park@aecom.com (610) 832-3584
Jean Youngerman	AECOM	QAPP Reviewer	Jean.youngerman@aecom.com (512) 419-5208
Ken Fucik	MVI	Project Manager	kenfucik@comcast.com (772) 419-9627
Cristina Thibeaux	EMTL	Laboratory PM	Cristina.Thibeaux@element.com (337) 235-0483 ext. 44044
David Daniel	EEUSA	Laboratory President	ddaniel@eeusa.com (985) 707-5442
Greg Southworth	OOC	Project Manager	greg@southworthconsulting.com (504) 904-7966

Action Items:

Action	Responsible Party	Due Date
Prepare QAPP	Michael Shadle, AECOM	September 28, 2018
Internal Review of QAPP	Jean Youngerman, AECOM Jeffrey Park, AECOM	September/October 2018
External review of QAPP	Ken Fucik, MVI	October 2018
Laboratory review of QAPP	Cristina Thibeaux, EMTL David Daniel, EEUSA	October 2018
OOC Review of QAPP	Greg Southworth	October 2018
USEPA Review of QAPP	USEPA Region 4 and USEPA Region 6	April 2019

Date of planning session: December 2018
Location: At respective offices of all participants
Purpose: Pre-sampling discussion and review of Sampling and Analysis Plan

Participants:

Name	Organization	Title/Role	Email/Phone
Michael Shadle	AECOM	Quality Assurance Officer	Michael.shadle@aecom.com (804) 290-2488
Jeffrey Park	AECOM	Aquatic Ecotoxicologist	Jeffrey.park@aecom.com (610) 832-3584
Ken Fucik	MVI	Project Manager	kenfucik@comcast.com (772) 419-9627
Cristina Thibeaux	EMTL	Laboratory PM	Cristina.Thibeaux@element.com (337) 235-0483 ext. 44044
David Daniel	EEUSA	Laboratory President	ddaniel@eeusa.com (985) 707-5442
Greg Southworth	OOC	Project Manager	greg@southworthconsulting.com (504) 904-7966
Operators	Various	Field Samplers	various

Action Items:

Action	Responsible Party	Due Date
Review of Sampling SOP	All participants	Prior to December 2018
Discussion of SOP and questions	All participants	December 2018

Date of planning session: November 2019 through August 2021
Location: At respective offices of all participants
Purpose: Data Validation and review

Participants:

Name	Organization	Title/Role	Email/Phone
Michael Shadle	AECOM	Quality Assurance Officer	Michael.shadle@aecom.com (804) 290-2488
Jean Youngerman	AECOM	Senior Quality Review	Jean.youngerman@aecom.com (512) 419-5208
Cristina Thibeaux	EMTL	Laboratory Project Manager	Cristina.Thibeaux@element.com (337) 235-0483 ext. 44044

Action Items:

Action	Responsible Party	Due Date
Receive chemical data from laboratory	Cristina Thibeaux, EMTL	Beginning 28 days after 1st sample submission
Receive acute toxicity data from WET testing laboratory	David Daniel, EEUSA	Beginning 28 days after 1st sample submission; Draft acute toxicity statistics may be reviewed after 24 hours.
Perform Data Validation	Michael Shadle, AECOM	28 days after receipt of data package
Perform peer review on data validation reports	Jean Youngermann, AECOM	14 days after receipt of data validation report
Finalize data validation reports	Michael Shadle, AECOM	7 days after receipt of reviewed data validation report

QAPP Worksheet #10: Conceptual Site Model
(UFP-QAPP Manual Section 2.5.2)
(EPA 2106-G-05 Section 2.2.5)

The conceptual site model is presented in the Joint Industry Project Study Plan for Treatment, Completion, and Workover Discharges: **Section 1.0**; **Section 2.0**; and **Section 3.0**.

QAPP Worksheet #11: Project/Data Quality Objectives
(UFP-QAPP Manual Section 2.6.1)
(EPA 2106-G-05 Section 2.2.6)

Data quality objectives (DQOs) are presented in the JIP study plan **Section 4.1** and **Table 4-1**.

QAPP Worksheet #12: Measurement Performance Criteria
(UFP-QAPP Manual Section 2.6.2)
(EPA 2106-G-05 Section 2.2.6)

The analytical methods and analytes of concern have not been determined yet. Therefore, method-specific measurement performance criteria cannot be determined. Project measurement performance criteria, however, can be identified:

Data Quality Indicator (DQI)	QC sample or measurement performance activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	RPD ≤ 35% when analytes are detected in both samples ≥ 5x PQL; absolute difference between detects ≤ 1x RL if one or both results < 5x PQL
Analytical accuracy/bias (contamination)	Laboratory/preparation blanks	No target analyte concentrations ≥ Practical Quantitation Limit (PQL)
Analytical Precision (laboratory)	Laboratory Control Sample Duplicates	Relative Percent Difference (RPD) ≤ 20%
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples	Analyte-specific
Analytical Accuracy/Bias (laboratory)	Matrix spike samples (if necessary)	Analyte-specific
Analytical Accuracy/Bias (matrix interference)	Matrix Spike Duplicates (if necessary)	Analyte-specific
Overall accuracy/bias (contamination)	Field Blanks	No target analyte concentrations ≥ PQL
Completeness	See Worksheet #34	See Worksheet #34

QAPP Worksheet #13: Secondary Data Uses and Limitations
(UFP-QAPP Manual Section 2.7)
(EPA 2106-G-05 Chapter 3: QAPP Elements for Evaluating Existing Data)

Data type	Source	Data uses relative to current project	Factors affecting the reliability of data and limitations on data use
Publicly available concentrations of constituents in TCW fluids.	Previous reports by USEPA or by others	Characterize TCW fluids.	No limitations on data use are expected.

QAPP Worksheet #14/16: Project Tasks & Schedule
(UFP-QAPP Manual Section 2.8.2)
(EPA 2106-G-05 Section 2.2.4)

See JIP Study Plan **Section 6.0** for the project schedule.

QAPP Worksheet #15: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits
(UFP-QAPP Manual Section 2.6.2.3 and Figure 15)
(EPA 2106-G-05 Section 2.2.6)

The analytical methods and constituents have not been determined yet. Therefore, constituent-specific detection/quantitation limits and project action limits cannot be determined at this time.

QAPP Worksheet #17: Sampling Design and Rationale
(UFP-QAPP Manual Section 3.1.1)
(EPA 2106-G-05 Section 2.3.1)

The sampling design and rationale are presented in **Section 4.0** of the JIP study plan.

QAPP Worksheet #18: Sampling Locations and Methods
(UFP-QAPP Manual Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.1 and 2.3.2)

Sampling locations and methods are presented in the following portions of the JIP study plan**: Section 3.0**; **Section 4.0**; **Table 3-1**; **Table 4-2**; **Figures 4-1** through **4-6**; and **Appendix A**.

QAPP Worksheet #19 & 30: Sample Containers, Preservation, and Hold Times
(UFP-QAPP Manual Section 3.1.2.2)
(EPA 2106-G-05 Section 2.3.2)

The analytical methods and constituents have not been determined yet. Therefore, sample containers, preservation, and holding times cannot be determined.

QAPP Worksheet #20: Field QC Summary
(UFP-QAPP Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.5)

The analytical methods and constituents have not been determined yet. Therefore, the field QC cannot be determined.

QAPP Worksheet #21: Field SOPs
(UFP-QAPP Manual Section 3.1.2)
(EPA 2106-G-05 Section 2.3.2)

SOP # or reference	Title, Revision, Date, and URL (if available)	Originating Organization	SOP option or Equipment Type (if SOP provides different options)	Modified for Project? Y/N	Comments
Appendix A	TCW Discharge Sampling SOP	AECOM	N/A	N	None
SR03.001	Receiving and Disbursement of Sample Kits & Samples and Procedure For Handling Questionable Samples, rev. 14, May 2018	EEUSA	N/A	N	None
ADM GEN 012	Receiving Laboratory Samples, Rev. 019, April 2018	EMTL	N/A	N	None

QAPP Worksheet #23: Analytical SOPs
(UFP-QAPP Manual Section 3.2.1)
(EPA 2106-G-05 Section 2.3.4)

The analytical methods and constituents have not been determined yet. Therefore, laboratory-specific standard operating procedures (SOPs) cannot be identified yet.

QAPP Worksheet #24: Analytical Instrument Calibration
(UFP-QAPP Manual Section 3.2.2)
(EPA 2106-G-05 Section 2.3.6)

The analytical methods and constituents have not been determined yet. Therefore, method-specific instrument calibration information criteria cannot be determined.

QAPP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection
(UFP-QAPP Manual Section 3.2.3)
(EPA 2106-G-05 Section 2.3.6)

EMTL

Quality manual, QM GEN 001, revision 19, effective date August 28, 2015, SP 501 and ADM GEN 027 describe the maintenance, testing, and inspection of instrumentation and equipment.

EEEUSA

Quality Assurance Plan, March 2018 describes the maintenance, testing, and inspection of instrumentation and equipment.

QAPP Worksheet #26 & 27: Sample Handling, Custody, and Disposal
(UFP-QAPP Manual Section 3.3)
(EPA 2106-G-05 Section 2.3.3)

Sampling Organization: JIP Study Participant

Laboratories: EMTL and EEUSA

Method of sample delivery (shipper/carrier): Samples dropped off directly from operator to EEUSA courier. The samples will then be shipped by EEUSA to EMTL for chemical analysis

Number of days from reporting until sample disposal: 45 days

Activity	Organization and title or position of person responsible for the activity	SOP reference
Sample labeling	EEUSA	Appendix A
Chain-of-custody form completion	Operator	Appendix A
Packaging	Operator/EEUSA	Receiving and Disbursement of Sample Kits & Sample and Procedure for Handling Questionable Samples, SR03.001
Shipping coordination	AECOM (Gary Smith); AECOM (Michael Shadle); AECOM (Jeffrey Park)/Laboratories (Cristina Thibeaux [EMTL]/David Daniel [EEUSA])/Operator	Appendix A
Sample receipt, inspection, & log-in	Cristina Thibeaux [EMTL]/ David Daniel [EEUSA])	Receiving Laboratory Samples, ADM GEN 012 (EMTL) / Receiving and Disbursement of Sample Kits & Sample and Procedure for Handling Questionable Samples, SR03.001 (EEUSA)

Activity	Organization and title or position of person responsible for the activity	SOP reference
Sample custody and storage	Cristina Thibeaux (EMTL) David Daniel (EEUSA)	Receiving Laboratory Samples, ADM GEN 012 (Element) / Receiving and Disbursement of Sample Kits & Sample and Procedure for Handling Questionable Samples, SR03.001 (Environmental Enterprise USA, Inc.)
Sample disposal	Cristina Thibeaux (EMTL) David Daniel (EEUSA)	Sample Disposal, ENV GEN 200 (Element) / Receiving and Disbursement of Sample Kits & Sample and Procedure for Handling Questionable Samples, SR03.001 (Environmental Enterprise USA, Inc.)

QAPP Worksheet #28: Analytical Quality Control and Corrective Action
(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

The analytical methods and constituents have not been determined yet. Therefore, method-specific analytical quality control and corrective actions cannot be determined.

QAPP Worksheet #29: Project Documents and Records
(UFP-QAPP Manual Section 3.5.1)
(EPA 2106-G-05 Section 2.2.8)

Sample Collection and Field Records			
Record	**Generation**	**Verification**	**Storage location/archival**
Field logbook	Operator	Project Manager	Project File
Chain-of-Custody Forms	Operator	Project Manager/Quality Assurance Officer	Project File
Deviations	Operator	Project Manager/Quality Assurance Officer	Project File
Corrective Action Reports	Operator	Project Manager	Project File
Correspondence	Operator	Project Manager/Quality Assurance Officer	Project File

Project Assessments			
Record	**Generation**	**Verification**	**Storage location/archival**
Data validation report	Quality Assurance Officer (Michael Shadle)	Project Chemist (Jean Youngerman)	Project File

Laboratory Records			
Record	**Generation**	**Verification**	**Storage location/archival**
Analytical Laboratory Data Packages	Laboratory	Project Chemist/AECOM Team	AECOM project files Laboratory maintains records in accordance with the QAM requirements.

QAPP Worksheet #31, 32 & 33: Assessments and Corrective Action
(UFP-QAPP Manual Sections 4.1.1 and 4.1.2)
(EPA 2106-G-05 Section 2.4 and 2.5.5)

Assessments:

Assessment Type	Responsible Party & Organization	Number/Frequency	Assessment Deliverable	Deliverable due date
On-site Field Sampling technical systems audit (TSA)	Operator	Every day of sampling	Field notes	24 hours following assessment
Management Review	AECOM Project Manager	Final review upon completion of field work	Included in final report to OOC and USEPA	No later than October 2021

Assessment Response and Corrective Action:

Assessment Type	Responsibility for responding to assessment findings	Assessment Response Documentation	Timeframe for Response	Responsibility for Implementing Corrective Action	Responsible for monitoring Corrective Action implementation
On-site Field Sampling TSA	AECOM Project Manager and Operator	Field Notebook and Field Sampling Corrective Action Memorandum	Immediate (notes written in field notebook) 1 week after receipt of Memorandum	Operator	Project Manager & AECOM QAO

QAPP Worksheet #34: Data Verification and Validation Inputs
(UFP-QAPP Manual Section 5.2.1 and Table 9)
(EPA 2106-G-05 Section 2.5.1)

Item	Description	Verification (completeness)	Validation (conformance to specifications)
	Planning Documents/Records		
1	Approved QAPP	X	
2	Contract	X	
3	Field SOPs	X	
4	Laboratory SOPs	X	
	Field Records		
5	Field logbooks	X	X
6	Equipment calibration records	X	X
7	Chain-of-Custody Forms	X	X
8	Sampling diagrams/surveys	X	X
9	Relevant Correspondence	X	X
10	Change orders/deviations	X	X
11	Field audit reports	X	X
12	Field corrective action reports	X	X
	Analytical Data Package		
13	Cover sheet (laboratory identifying information)	X	X
14	Case narrative	X	X
15	Internal laboratory chain-of-custody	X	X
16	Sample receipt records	X	X
17	Sample chronology (i.e. dates and times of receipt, preparation, & analysis)	X	X
18	Communication records	X	X
19	LOD/LOQ establishment and verification	X	X
20	Standards Traceability	X	X
21	Instrument calibration records	X	X
22	Definition of laboratory qualifiers	X	X
23	Results reporting forms	X	X
24	QC sample results	X	X
25	Corrective action reports	X	X
26	Raw data	X	X

QAPP Worksheet #35: Data Verification Procedures
(UFP-QAPP Manual Section 5.2.2)
(EPA 2106-G-05 Section 2.5.1)

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field logbook	QAPP, TCW Discharge Sampling SOP	Verify that records are present and complete for each day of field activities. Verify that all planned samples including field QC samples were collected and that sample collection locations are documented. Verify that changes/exceptions are documented and were reported in accordance with requirements.	Each sampling event – Sampling Company At conclusion of field activities - Project QA Officer/Project Manager
Chain-of-custody forms	QAPP, TCW Discharge Sampling SOP	Verify the completeness of chain-of-custody records. Examine entries for consistency with the field logbook. Check that appropriate methods and sample preservation have been recorded. Verify that the required volume of sample has been collected and that sufficient sample volume is available for QC samples (e.g., MS/MSD). Verify that all required signatures and dates are present. Check for transcription errors.	Each sampling event – Sampling Company At conclusion of field activities - Project QA Officer/Project Manager
Laboratory Deliverable	QAPP	Verify that the laboratory deliverable contains all records specified in the QAPP. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported according to plan. Compare the data package with the CoCs to verify that results were provided for all collected samples. Review the narrative to ensure all QC exceptions are described. Check for evidence that any required notifications were provided to project personnel as specified in the QAPP. Verify that necessary signatures and dates are present.	Before release – Laboratory QAM Upon receipt – QA Officer
Audit Reports, Corrective Action Reports	QAPP	Verify that all planned audits were conducted. Examine audit reports. For any deficiencies noted, verify that corrective action was implemented according to plan.	Project QAM

QAPP Worksheet #36
Data Validation Procedures
(UFP-QAPP Manual Section 5.2.2)
(EPA 2106-G-05 Section 2.5.1)

Data Verification: AECOM

Data verification is the process of verifying that qualitative and quantitative information generated relative to a given sample is complete and accurate. All chemical data will be provided to AECOM in a Type I data package by the laboratory. The data package contains raw data and will be reviewed by the AECOM data validator for compliance with the laboratory SOPs and usability according to this QAPP. Draft results and the supporting raw data will not be deleted or discarded. Comments from review of the data package will be provided to the laboratory that will generate a revised laboratory data package, if necessary. 100% of the data will be reviewed using the criteria established in the methods listed by the laboratory in their own internal SOPs. Data qualifiers, used to further identify potential quality control/quality assurance deficiencies, will be applied following USEPA National Functional Guidelines for Organic and Inorganic Data Review. The data validator applies the following data evaluation qualifiers to analysis results, as warranted:

Qualifier	Definition
R	Unusable result. Analyte may or may not be present in the sample.
B	Not detected substantially above the level reported in the laboratory or field blanks.
J	Analyte present. Reported value may not be accurate or precise.
UJ	Not detected. Reporting limit may not be accurate or precise.

Additional qualifiers, called reason codes, will be used to further assist the data reviewer and data user in determining the rationale for the qualification. The list of reason codes will be appended to each report (if necessary). Laboratory results greater than the MDL but less than the RL are qualified J and should be considered to be estimated values. The data validation review process described above will be performed on 100% of the data generated for the sampling event. The data validation review process will include a manual review of the instrument-related QC results for calibration standards, blanks, and recoveries (**Worksheet 24**) to be consistent with Stage 3 Validation Manual (S3VM) of the EPA Guidance for Labelling Externally Validated Laboratory Analytical Data for Superfund Use (EPA-540-R-08-005, 2009).

QAPP Worksheet #37: Data Usability Assessment
(UFP-QAPP Manual Section 5.2.3 including Table 12)
(EPA 2106-G-05 Section 2.5.2, 2.5.3, and 2.5.4)

Identify personnel (organization and position/title) responsible for participating in the data usability assessment:
OOC Project Manager
AECOM Program Manager
AECOM Project Manager
AECOM Quality Assurance Officer

Summarize the data usability assessment process including statistics, equations, and computer algorithms that will be used to analyze the data:

Step 1	**Review the project's objectives and sampling design** Review the data and evaluate that the results and associated QC samples satisfy the objectives of the DQOs. Evaluate field notes to verify that the wells have been sampled correctly.
Step 2	**Review the data verification and data validation outputs** Review the data validation report and conclusions. Determine usability of data based on data validation report and conclusions. Determine if any QC anomalies will potentially bias the results. Review field notes to determine if sampling procedures deviated from planned activities.
Step 3	**Verify the assumptions of the selected statistical method** Sample collection and sample collection techniques between individual wells should be as similar as possible. Deviations in sampling techniques may bias individual results. Analytical methods should remain constant from the initiation of the project to the conclusion. The client has identified the 50 wells to be used for this study. It is assumed that the 50 wells chosen are representative of the well fluids being analyzed for the purpose of the study.

Step 4	**Implement the statistical method** All data will be used for the study, as reported by the laboratories, unless one or more of the conditions are present: 1 – During review of the data during validation, if any of the data are qualified as unusable (i.e., "R"). 2 – A review of the sampling techniques identifies inconsistencies with sample collection. 3 – A change in analytical methods and approaches If one or more of these conditions are present, then the PM will review the data and determine if the variances warrant exclusion of the data in the study.
Step 5	**Document data usability and draw conclusions** Data validation will provide a level of data usability which will aid the PM in making necessary conclusions on the results. Assessment of the DQIs (precision, accuracy, sensitivity, completeness, comparability, and representativeness) will further aid in a final determination if the data can be used as intended or if any limitations will be applied to the data sets.